مفاهيم الجيولوجيا (إنجليزي)

الصف الثالث الثانوي

GEOLOGY AND THE MATERIALOF THE EARTH

Geology (Earth science is the science which deals with everything has relationship with Earth, its components, its movements, its history, its phenomena and its wealth . It explains all the geological phenomena.

Different Branches of Geology:

Physical Geology: concerned with the external and internal processes affecting the rock of Earth's crust.
Mineralogy and crystallography: is concerned with the study of minerals, their physical and chemical properties and the forms of their crystal systems.
Hydrogeology: is related to whatever concerns groundwater aquifers, supply and withdrawal and use of water in agriculture and land reclamation.
Structural Geology: deals with the different structures, which exist on rocks resulting from the effect of both external and internal forces that continually work with variable degrees of forces on Earth's crust.
Stratigraphy: deals with the rules and conditions that govern the formation of the layers and the sites of deposition after weathering and transportation by different natural factors.
Paleontology: deals with studies of fossils and the remains of living organisms, that characterize the sedimentary rocks, by which we can determine the geologic age and environmental conditions.
Geochemistry: deals with the study the chemical structure for minerals and rocks, distribution of elements and determine the type and ratio of mineral ore in the Earth crust.
Engineering Geology: is the branch which deals with the study of mechanical and geometrical properties of rocks in order to establish the different engineering structures such as dams, tunnels, giant bridges and skyscrapers and towers.
Petroleum Geology: deals with all processes concerning the formation of oil or gas, their migration and accumulation in reservoirs rocks.
Geophysics: is the branch which deals with the exploration of oil traps, ore deposits and ground water using physical sensitive sets.

The importance of Geology in our life:

The most important benefits of Geology:
1. Prospection for mineral ores as gold, iron, silver and others.
2. Discovering the different energy resources as coal, oil, natural gas and radioactive minerals.
3. Searching about building materials as limestone, shale, marble, gypsum and others.
4. Help in planning for habitation projects as building new cities, dams, tunnels and establishment of safe districts from the dangers and disasters.
5. Search of raw materials used in many chemical industries as sodium, sulphur, chlorine that necessary for manufactures of fertilizers, insecticides and drugs.
6. Exploration of sources of groundwater for the new reclaimed areas .
7. Geology plays an important role in the success of military operations.

Components of the Earth planet

The earth crust

- **A thin sphere of igneous, sedimentary and metamorphic rocks.**
- **The earth crust is divided into continental crust (sial) and oceanic crust (sima).**
- **It's in state of equilibrium in spite of difference in density of the rocks of these two crusts**

	Continental crust	Oceanic crust
Thickness	About 60 km. in continents	8 – 12 km. below seas and oceans
Components	Granitic sial rocks	Sima basaltic rocks
Mineral composition	Silica 70% and aluminum	Silica 45% and magnesium

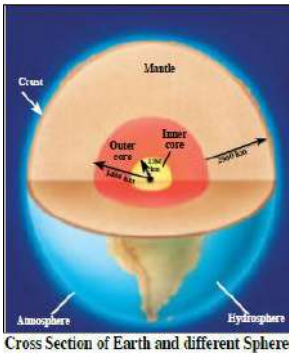
The mantle

The volume of the mantle : more than 80% (4/5) of the volume of the earth rocks

The thickness of mantle : 2900 km.

The mantle consists of solid rocks of Fe, Mg and Si oxides except the upper part (The asthenosphere)

The asthenosphere : The upper part of the mantle (350 km. thickness) which is partially molten and elastic rocks which behave as fluids under certain conditions resulting from pressure and temperature that allow for the spread of convection currents which permits the drifting of the continents above .



Cross Section of Earth and different Sphere

The core

The core volume : one sixth of earth volume (16.7%) .

The core mass : one third of earth mass as it consists of sense materials .

The core radius : 3486 km.

The pressure in the core : reaches millions of atmospheric pressure .

The core temperature : more than 5000 ^{0}C

(a) The core is divided into outer molten core and inner solid one .

(b) Explaining the earth magnetic field : scientists were able to explain the origin of the magnetic field of Earth may be generated from the presence of outer core that composed of molten material revolves around the rocky solid inner core.

	Outer core	Inner core
Thickness	2100 km.	1386 km.
Components	Molten Fe , Ni at 3 million atm.	High density solid rocks
density	10 gm/cm^3	14 gm/cm^3

The atmosphere

. Both air density and atmospheric pressure decrease upward to be low as one half of its value for every 5.5 km high till it vanished at higher altitude.

. The ratio of Oxygen decreases upward so we feel suffocation at high altitude.

The hydrosphere

The sea level : is the level of the hydrosphere surrounding the earth from all directions and is internationally recognized and all heights of different topographical features are attributed to such as mountains, plains, plateaus, valleys and others features that forming the rocks of earth's crust .

The geological structure

The geological structure :

. All types of rocks constituting the crustal material of the earth, particularly the sedimentary rocks never stay as they have been deposited but subjected from time to time to internal and external forces that make the rocks take new forms and situations. These forms what are known as geological structures.

Types of geological structure

(1) Primary geological structures :

These type of structures, remains in rocks of the crust under the influence of climatic and environmental conditions such as drought, heat and the effect of wind and water currents ...etc.

.Examples of primary geological structures in the earth crust rocks :

1- Mud cracks
2 – ripple marks
3- graded bedding
4- cross bedding

(2) Tectonic geological structures (secondary structures)

. They are huge fissures and cracks and violent torsions which often we see deform the crust seen in mountainous and desert areas.
.They're affected by the internal forces and earth movements .
. These forces causing earthquakes, transgression and regression of seas and oceans, and drifting the continents and their movements around each other.
Examples: folds, faults and fractures or joints

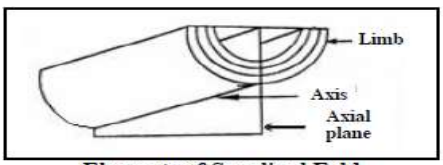
Types of tectonic structure :

First : Folds

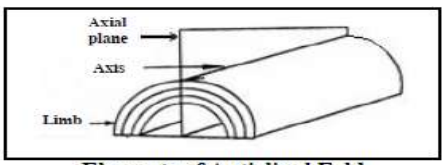
The folds elements :

1- The axial plane : it is the imaginary plane which divides the fold into two equal and identical parts in all aspects .
2- The fold axis : which is defined as the imaginary line of intersection of the axial plane with any surface of all different layers.
Since any fold always consists of a succession of different layers and each one of these layers has its own axis, then it is expected that the axial plane should contain all these axes.
3- Fold limbs : They are represented as rock blocks which found on both sides of axial plane.
Classification of folds : They're classified into anticline folds and syncline folds

Anticline fold	Syncline fold
The fold is wrinkling in the rocks of the earth crust as a result of pressure on the layers .	
Layers bend up	Layers bend down
Oldest layers in the center	Recent layers in the center



Elements of Synclinal Fold



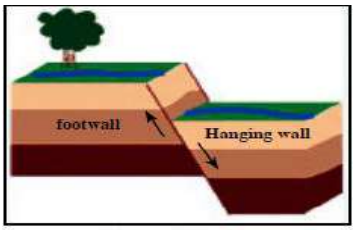
Elements of Anticlinal Fold

(2) Faults

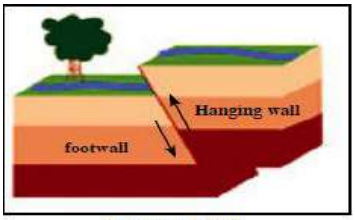
Faults : They're fractures or cracks cutting rock masses and accompanied by relative movement of rock masses along both sides of fault plane.
Fault elements :
1- fault plane : it is the plane on both sides, the fractured rock masses move with relative movement to each other resulting in displacement.
2- hanging wall: the rock mass which found above the fault plane.
3- foot wall : the rock mass which found under the fault plane.

Types of faults

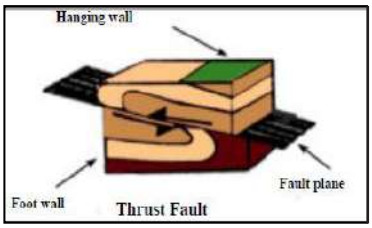
Normal fault	Reverse fault
A fracture produced from tension force	A fracture produced from compression force
the hanging wall is moving downward along the fault plane with respect to those that occupying the footwall.	the hanging wall is moving upward along the fault plane with respect to those that occupying the footwall.



Normal Faults



Reverse Fault



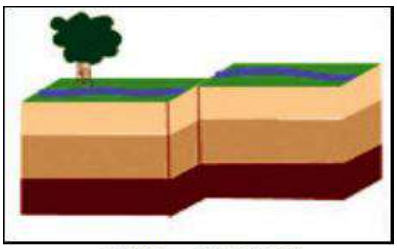
Thrust Fault

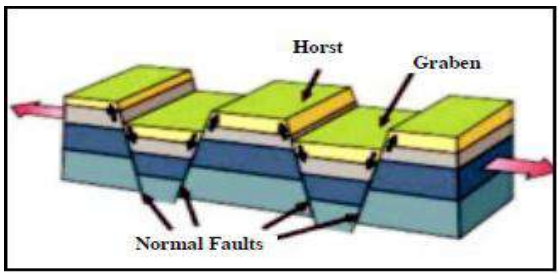
Thrust fault (creeping fault) :

. It is a type of reverse faults and distinct from the reverse fault that its fault plane is almost horizontal (with low angle of dip). .It is called "creeping fault" because its broken rocks almost creep horizontally for certain distance on the fault plane.

Strike slip fault : where the rock mass moves horizontally in the same plane without any vertical displacement.

Graben	Horsts
The rocks are affected by two normal faults combine in hanging wall.	The rocks are affected by two normal faults combine in footwall


Strike - slip Fault



(3) Joints

.These are fractures present in different types of rocks; igneous, sedimentary and metamorphic without any evidence of movement.

The distance between joints varies from a few centimeters to tens of meters; depending on:

*** The type of rock.**

*** The thickness of the rock.**

*** The method of response of rock to the forces affecting it.**

Importance of joints :

Ancient Egyptians had benefited from the presence of joints in the rocks in their constructing temples and tombs, as well as in making obelisks.

Historical Geology

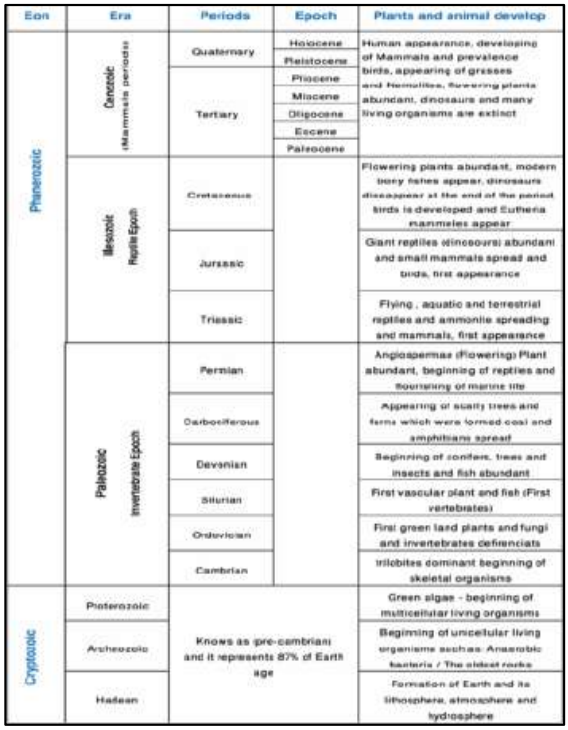
Geological time scale: where the geological events are put in its correct order .This geological time scale is not complete in one place due to periods of time which sediments stops as some layers disappear as result of denudation or non-deposition of some time which is called (unconformity surface)

.The history of earth into two large eons:

1/ CRYPTOZOIC (unknown life eon) which starts with the begins of earth history till 542 million years ago - and this eon divided into three eras (Hadean - Archean - Proterozoic)

2/ PHANEROZOIC (Known life eon) which starts from 542 million years till now.

And this eon is divided into three eras which are (Paleozoic - Mesozoic - Cenozoic) and every era can be divided into periods and each period can be divided into rimes(Epochs)



Eon	Era	Periods	Epoch	Plants and animal develop
Phanerozoic	Cenozoic (Mammals periods)	Quaternary	Holocene	Human appearance, developing of Mammals and prevalence birds, appearing of grasses and Hominites, flowering plants abundant, dinosaurs and many living organisms are extinct
			Pleistocene	
		Tertiary	Pliocene	
			Miocene	
			Oligocene	
			Eocene	
			Paleocene	
	Mesozoic (Reptile Epoch)	Cretaceous		Flowering plants abundant, modern bony fishes appear, dinosaurs disappear at the end of the period, birds is developed and Eutheria mammeles appear
		Jurassic		Giant reptiles (dinosaurs) abundant and small mammals spread and birds, first appearance
		Triassic		Flying , aquatic and terrestrial reptiles and ammonite spreading and mammals, first appearance
	Paleozoic (Invertebrate Epoch)	Permian		Angiospermas (Flowering) Plant abundant, beginning of reptiles and flourishing of marine life
		Carboniferous		Appearing of scaly trees and ferns which were formed coal and amphibians spread
		Devonian		Beginning of conifers, trees and insects and fish abundant
		Silurian		First vascular plant and fish (First vertebrates)
		Ordovician		First green land plants and fungi and invertebrates defrenciats
		Cambrian		Trilobites dominant beginning of skeletal organisms
Cryptozoic	Proterozoic	Knows as (pre-cambrian) and it represents 87% of Earth age		Green algae - beginning of multicellular living organisms
	Archeozoic			Beginning of unicellular living organisms eschas: Anaerobic bacteria / The oldest rocks
	Hadean			Formation of Earth and its lithosphere, atmosphere and hydrosphere

.Methods of determination age of earth :

1- The decay of Radioactive substances which have determined the age of Earth by 4.6 billion years (4600 billion years old) .

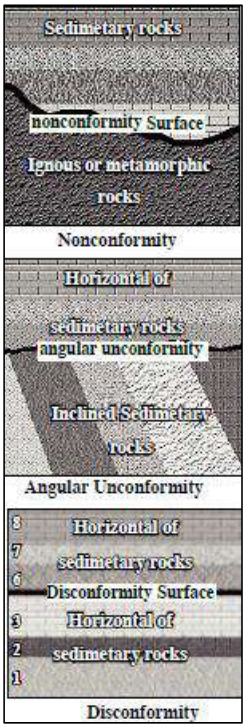
2- Developing of life which depends on fossils that is widely spread geographical and have limited time range which is called **index fossil.**

Structures of unconformity

Unconformity surface is denudation or non-deposition surface. It is clear and distinctive, It separates between two groups of rock masses and indicates the absence of deposition for periods of time up to tens of millions of years

Evidences indicating Unconformities:

1. Presence of rounded conglomerate lie directly above the surface of unconformity.
2. Sudden change in the sequence of fossil contents between the layers.
3. Difference in the inclination (angle of dip) of strata on both sides of the surface of unconformity.
4. The presence of geological structures or dykes in layers and they do not exist in other overlying layers .



Types of unconformty :

1- Nonconformity :

This type is found between the sedimentary rocks and the igneous or metamorphic ones where the sedimentary rocks are the more recent ones (younger ones) .

2- Angular unconformity :

The group of older rocks are inclined
while the group of the recent rocks are horizontal
OR the two groups are inclined in different directions .

3- Disconformity :

a) It's between two parallel groups of sedimentary rocks (almost horizontalposition)
b) It's because of erosion or a period of non deposition .
c) It's difficult for the geologist to determine the surface of disconformity

Minerals

Uses by paleolithic
1- Chert : making knives and spears to hunt and defend himself 2- Hematite and limonite : drawing on caves walls 3- Clay minerals : after knowing fire he made hard ceramic 4- Coloured Minerals: for ornamentation (amethyst, Malachite, emeralds and turquoise
Recently
1- Calcite : cement industry 2- Quartz : glass industry 3- Iron oxides (magnetite and hematite): iron and steel industry 4- Feldspars : porcelain industry 5- Metals : like gold and copper after formatting in many life uses
Properties of minerals and rocks of earth crust
The earth crust consists of igneous, sedimentary and metamorphic rocks Most rocks consist of many minerals like granite which consists of feldspar, mica, quartz Some rocks consist of one mineral like the limestone which consists of calcite mineral.

Definition of the mineral

The mineral is solid, inorganic, naturally occurring substance having definite chemical composition (can be expressed) and a distinct crystalline form.

Minerals formation

Native minerals	Some minerals consist of one element like: gold, sulphur, copper , graphite and mass (carbon only)
Compound minerals	Most minerals consist of combination of two or more elements forming constant chemical compound like quartz (silicon dioxide), calcite (calcium carbonates)

Chemical composition of minerals

	Mineral groups	Examples of minerals
The most ↓ The less	Silicates	Quartz – orthoclase – plagioclase – mica –amphibole – pyroxene – olivine
	Carbonates	Calcite - dolomite
	Oxides	Hematite – magnetite
	Sulphides	Pyrite - Galina – sphalerite
	Sulphates	Gypsum – anhydrite – barite
	Native elements minerals	Gold – copper – graphitr – sulpher – diamond.

(Chemical groups which forming minerals)

The element	Weight percentage
Oxygen	46.6 %
Silicon	27.7 %
Aluminum	8.1 %
Iron	5.0 %
Calcium	3.6 %
Sodium	2.8 %
Potassium	2.6 %
Magnesium	2.1 %
rest of elements	1.5 %

The common elements of Earth crust

Crystalline structure of minerals

The crystal forms.: The mineral consists of arrangement of atoms within a mineral in orderly arrangement,

The crystal is solid geometrical body has outer plane surfaces known as crystal faces.

The basic elements for crystals

Mineral crystals can be classified into several different crystal systems. The classification crystal systems depends on the lengths of the crystal axes and angles between these axes Where (a , b , c) indicate the lengths of axes , while (α , β , γ) indicate the angles between axes

Crystal system	Crystal description	Crystal axes
Cubic	three axes which are equal in lengths and has perpendicular angles.	$(a_1 = a_2 = a_3)$ $(\alpha = \beta = \gamma)$
Tetragonal	three perpendicular axes, two of them are equal in length and the third is different	$(a_1 = a_2 \neq c)$ $(\alpha = \beta = \gamma)$
Orthorhombic	The crystal has three axes which are unequal in lengths and perpendicular angles	$(a \neq b \neq c)$ $(\alpha = \beta = \gamma)$
Monoclinic	three axes which are unequal in lengths, two axes are perpendicular and the third is inclined	$(a \neq b \neq c)$ $(\alpha = \gamma \neq \beta)$
Triclinic	The crystal has three axes, all are different in lengths and are not perpendicular	$(a \neq b \neq c)$ $(\alpha \neq \beta \neq \gamma)$
Hexagonal	The crystal has three horizontal axes which are equal in length, intersects each other by equal angels. They are perpendicular to the forth axis which differs in length, The fourth vertical axis is hexametrical with the presence of horizontal symmetrical plane.	
Trigonal	The crystal has three horizontal axes which are equal in lengths, intersects each other by equal angels. They are perpendicular to the forth axis which differs in length. The fourth vertical axis is trimetric with no horizontal symmetrical plane.	

Physical properties of minerals

1- Optical properties :

These properties depend on the interaction between the incident light on the mineral and that reflected from its surface.

(A) Transparency : The ability degree to which light can pass through minerals. :

a) Transparent mineral: we can see a clear picture through it.

b) Translucent mineral: The picture seen through it is not clear.

c) Opaque mineral: The mineral does not transmit light at all.

(B) Luster: Luster Is the ability of mineral to reflect light that falling on its surface.

1- Metallic luster : Can reflect light so much that the mineral is bright or brilliant such as in (pyrite – galena – gold)

2-Non metallic luster (Vitreous (glassy)as in(quartz and calcite)) / Pearly as in (feldspar) / Adamantine luster as in (diamond). / Dull or earthy luster: The least intensity luster and its surface is matte (dull) as in (kaolinite)

(C) Colour : depends of the length of light waves reflected from its surface

- **Most of minerals change the colour by changing its chemical composition or contain small portion of impurities may change the colour of the same mineral**

Quartz which found in different colours : rock crystal (pure transparent) – Rose (manganese impurities) purple to violet quartz (amethyst) the colour is due to impurities of iron oxides – milky quartz is white like milk due to minute gas bubbles - smoky quartz, its grey to black colour due to breaking some bonds when they are exposed to high energy radiations

Sphalerite (zinc sulphides) : has many colours
a- yellow transparent : free from impurities
b- Brown sphalerite : Few Fe atoms replaces some Zn atoms
Some minerals of constant colours like yellow sulphur and green malachite (hydrous copper carbonates)
(D) Streak : The colour of the mineral powder
Streak has a constant colour for minerals whose colour changes due to changing type or quantity of the impurities
Hematite" mineral has two colours dark grey and red while its streak is red
pyrite which is characterized by golden colour, its streak is black
quartz which has different colors, its streak is white only.
(E) Play of colour : Minerals change their colour when moved in front of human eyes in the different directions
1- opal shows spangling (cat eyes)
2- Diamond disperses falling light on it into red and violet then gives strong luster in all directions.

2- Cohesive properties

1. Hardness: It's the ability of the mineral to resist scratching.
Hardness is determined numerically according to the "Moh's" scale in which minerals are arranged from 1 to 10 in degree of hardness.
Determination of hardness in the field or lab using :
1- Sets oh hardness pens
2- objects with common usage in our daily life with known hardness,
3- "Moh's" scale in which minerals are arranged from 1 to 10 in degree of hardness.

Mineral	Talc	Gypsum	Calcite	Fluorite	Apatite	Orthoclase	Quartz	Topaz	corundum	Diamond
hardness	1	2	3	4	5	6	7	8	9	10

Uses of hardness
Distinguish between natural and precious gemstone that are expensive and those industrially imitation ornamental stones of glass material or aluminum oxide.
2. Cleavage: It's the ability of the mineral to split along planer surfaces representing the weaker planes produce smooth surfaces when minerals are broken or pressed.
a) Cleavage in one direction: Mica is of flaky cleavage and graphite is good basal cleavage
b- Cleavage in more than one direction : Cubic in halite, galena and rhombohedra in calcite
3- Fracture: It's the shape of surface resulting from the breaking the mineral not follow any described plane of cleavage. Quartz and chert having no cleavage but concoidal fracture .
4. Malleability and ductility:
The ease or possibility of malleable and ductile a mineral to form a thinner sheet or wires such as gold, silver or copper.

3- Other Properties:

Specific gravity: Is the ratio between mineral mass and the mass of the same volume of water. Galena is 7.5 , Gold is 19.3
Magnetic properties: in terms of their attraction to magnet as magnetite and hematite or not attraction with magnet as gold and diamond.
Mineral taste : Salty like halite

Rocks

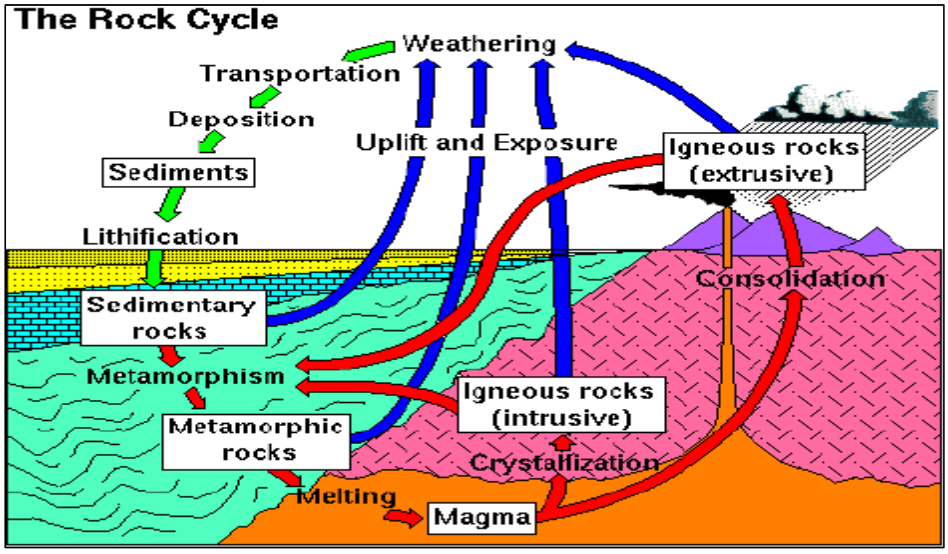
The rock is a natural solid body consist of number of minerals combined together at different ratios and sometimes consists of one mineral only.

Each rock is characterized by definite chemical structure so it has its own physical properties that distinguish it from others.

Types o rocks in nature according to their origin

Rocks	Mode of origin	General characters
Igneous	It is formed due to cooling and crystallization of molten material (magma), is called "the mother of rocks"	Massive- crystallized - non porous – not contain fossils
Metamorphic	As a result of effected by intense heat or heat and pressure	Laminar or massive- crystallized – non porous – deformed fossils
Sedimentary	Due to lithification and cementation of deposits by cement materials	stratified (found in layers), rarely crystalline ,often porous and often contain fossils.

Rocks cycle in nature



Igneous rocks

Igneous rocks are formed by the crystallization and solidification of molten rock materials by cooling.

Magma is viscous liquid and known as magma or lava and contains the eight elements of silicate minerals in form of ions, in addition to some gases (the most important of them is water vapour).

Bases of classification of igneous rocks

They can be classified according to :

1- Place of crystallization : which affects rate of magma cooling and the size of ceystal beside the shape of the texture (plutonic – intruded – volcanic)

2- Mineral composition : Depend on the chemical composition, temperature of crystallization of melting of minerals (ultra basic – basic – intermediate – acidic)

Classification of igneous rocks due to place of formation:

p. o. c	plutonic	intruded	surficial
Place	Deep in the earth	Inside the earth layers	Above earth surface
Rate of cooling	Slow	Faster then Slow	Very fast
texture	Coarse grain, rough	Porphyritic	Fine or Glassy
crystals	Large, few in number	Large in small matrix	Very Small
example	Granite, diorite, gabbro, Peridotite	Dolerite, micro diorite, micro granite	Basalt, andesite, rhyolite, obsidian, pumice, Komatite

Porphyritic texture is a mixture of large crystals in a matrix of smaller crystals of the same mineral composition , characterizing the intruded igneous rocks

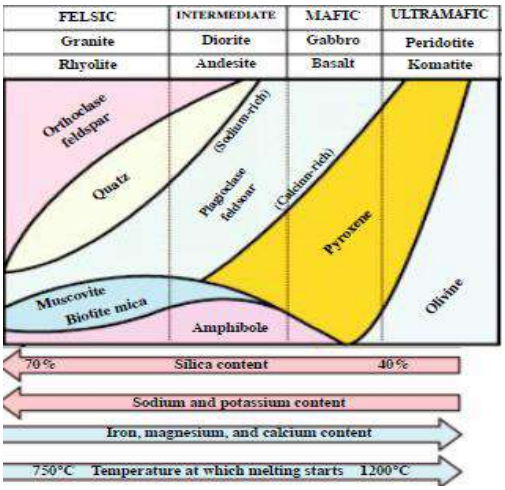
Classification of igneous rocks according to mineral composition

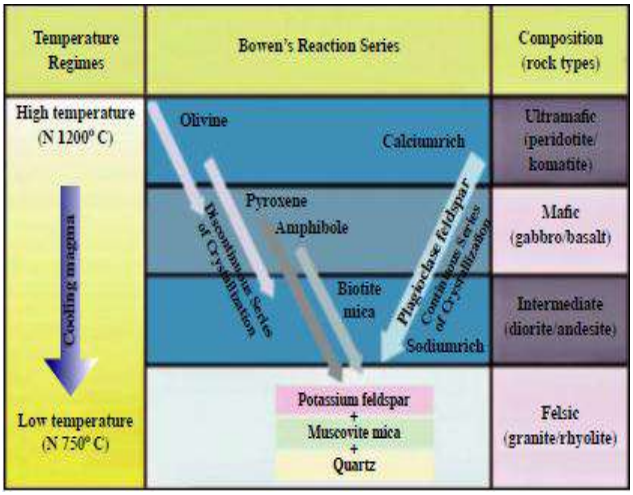
p. o. c	Acidic	Moderate	basic	Ultra basic
% of silica	More than 66%	55-66 %	45 – 55 %	Less than 45%
Minerals with silica	Na, K , mica feldspar ,quartz, amphibole	Na, Ca , Na plagioclase, pyroxene , amphibole, mica, quartz	Olivine, pyroxene, amphibole, Ca plagioclase feldspar	Olivine, pyroxene and calcic feldspar
Colour	Light rosy	Between light and dark	Black	Dark black
Ex.	Granite, micro granite,rhyolite, obsidian,pumice	Diorite, micro diorite, andesite	Gabbro, dolerite, basalt	Peridotite komatite

Formation of igneous rocks

Bowen reaction series

Mineral composition of igneous rocks





Equivalent igneous rocks

These are rocks of the same chemical and minerallic composition but of different texture and grain size as a result of difference in the place of formation

plutonic	Intruded	volcanic
Granite	Micro granite	Rhyolite, obsidian, pumice
Diorite	Micro diorite	andesite
Gabbro	Dolerite	basalt
Peridotite		Komatite

Shapes and positions of igneous rocks in nature :

A) Batholiths :

The largest intruded igneous rocks which extend for hundreds of km. and its thickness is several km.

B) Domes :

Produced when magma rises in narrow slot and then accumulates, rather than spreading horizontally .From the examples of domes are :

Laccolith	Loppolith
when magma of high viscosity press on the layers above it causing its bending upwards forming anticline fold .	when magma of low viscosity causes bending of the rocks below it forming syncline fold.
Dykes	**Sills**
When the magma is intruding and cutting the surrounding rocks .	When the magma intrudes the surrounding rocks but being concordant (parallel) to the layers surfaces not cutting them .

2- Shapes of extruded volcanic igneous rocks :

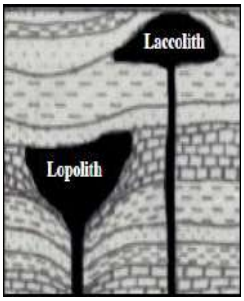
A) Lava flow : Solidified lava on the earth surface as a result of volcanic eruptions and take the shapes of **pillows or ropes .**

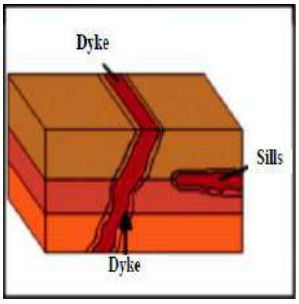
B) Pyroclastic : Resulted from the breaking down of volcanic necks. They're :

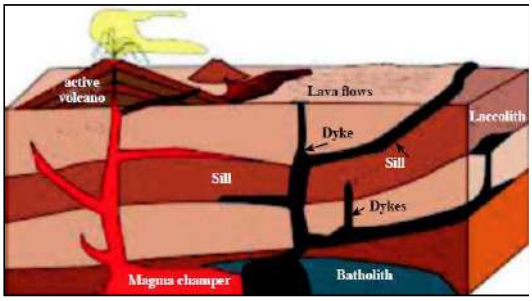
1- Volcanic breccias : Masses of sharp angles around the volcano .

2- Volcanic ashes : Very small grains carried by winds for large distances and may cross seas to fall in other continents .They increase soil fertility .

C) Volcanic bombs: oval rock masses consist of the lava substances when lava freezes (solidifies) near from the earth surface.







Volcanoes

It's an opening in the earth crust which permits the passage of molten rocks and prisoned gases outside it to the earth's surface

Reasons of volcanoes :

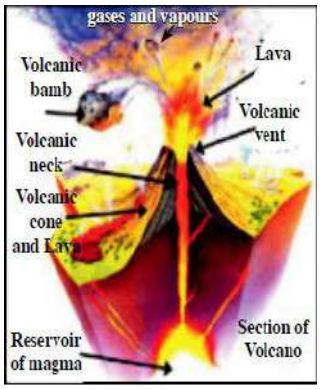
1- The main force in the volcanic eruption is the energy of the entrapped gases. That will be clear in the regions of injection of the tectonic plates which lead to cracks makes volcanic eruptions .

2- When magma reaches the earth surface, it will be called lava flow .

3- When lava expose to air and normal temperature, it cools, solidifies to form the volcanic rocks.

Volcanoes components:

The opposite figure represents the parts of a volcano, which consists of:



- **Volcanic Vent (Crater)**
- **Volcanic neck:** The volcanic substances are erupted through it into the crater.
- **The volcanic cone:** It represents the shape of the volcano and contains the volcanic vent.

Volcanoes products:

1- lava" come out the craters, with estimated temperature about 1200°C
2- gases and vapours such as ammonia, hydrogen sulfide, carbon dioxide, water vapour and others,

Types of volcanoes:

a) Extinct (inactive) After the eruption of the volcano , most of them become inactive where the magma chamber will be free from the molten magma.

b) Permanent volcanoes: These are of continuous like **Stromboli** (in Italy)

c)Discontinuous volcanoes : some erupt at discontinuous periods like **Vesuvius** in Italy and **Etna** in Sicily island

The effects and benefits of volcanoes:

1- They add annually millions of tons of volcanic rocks to the earth's surface which may form volcanic hills or mountains.
2- Appearance of new volcanic islands if the eruption is under sea .
3- The formation of a very fertile soil by the volcanic ash.
4- The formation of rounded lakes as a result of the collection of water in the openings of the inactive volcanoes.
5-The formation of metamorphic rocks when the erupted materials touch any rocks causing its metamorphism.

Sedimentary rocks

Sedimentary rocks are formed due to deposition of products (detritus) of weathering processes, whether they are solid or soluble and are carried by transportation natural agents to depositional basins so they are deposited in parallel layers one over the other.

Characteristics of Sedimentary Rocks:

Area : three quarters of the earth surface in thin layers
Volume : 5% of the earth crust rocks
Economic importance : Contain economic deposits (limestone, phosphates, coal, iron and sandstone)
Includes muddy rocks in which oil, natural gas & Kerogyn are formed and also Porous rocks like sandstone, limestone and sand in which oil, natural gas & underground water are stored.

Classification of sedimentary rocks

They're classified according to the mode of their origin to :

First : Clastic sedimentary rocks

They're classified according to the dominant volume of its solid components to :

deposits	components	diameter	Lithified rock by cement material
Gravel	pebbles and boulders	More than 2 mm.	Conglomerates, Breccia
Sand	Quartz grains	62 micron- 2 mm.	Sandstone
Mud	silt	4 – 62 microns	Laminated mud (Shale)
	clay	Less than 62 microns	
	Laminated mud (shale) :cohesive muddy rocks of silt, clay showing lamination or foliation due to compression of its components		

Second : Chemical sedimentary rocks

They're formed as result of precipitation of the dissolved salts in water which is due to evaporation of water and the increase of salts concentration or due to chemical reactions

1. Calcareous rocks: as limestone which is found in stalactite and stalagmite and Dolomite.

2. Silica rocks as Flint rock (light and dark).

3. Evaporates rocks : as a result of the evaporation of water from lakes like :
Gypsum (hydrous calcium sulphate),
Anhydrite (anhydrous calcium sulphate)
Table salt rock which is halite mineral (sodium chloride).

Iron ores sediments: Red iron oxide (hematite)

Third : Organic and biochemical sedimentary rocks

(1) Limestone rocks : Calcium carbonates rocks due to accumulation of skeletons of solid internal and outer parts of marine organisms
Invertebrates like (oysters, corals, foraminifera) or vertebrates (fish)

(2) Phosphates rocks : contain fossilized remains of marine animals vertebrate containing phosphate in addition to phosphates minerals components.

Energy sources in the sedimentary rocks

(1) Coal :
Organic deposits of economic importance and one of energy resources
It is formed when plants are buried in the bottom of the earth away from oxygen for long time, so the plant tissues lost their volatile constituents and carbon gets concentrated forming coal.

(2) Oil and Gas: Hydrocarbons which have been formed by the decay of animal and plant remains of marine away from atmospheric air.
Source rocks : Where organisms are matured at a depth of 2-4 km in the ground and the temperature ranges between 70 to 100□C, and then changed into liquid and gaseous states of hydrocarbons.
Reservoir rocks : Porous rocks of sand, sandstone and limestone and the matured hydrocarbons substances migrate there

Oil shale (Kerogen): It is a muddy rock rich in hydrocarbons, are mostly of plant origin and it is a waxy solid state known as kerogen,
It decomposes (turns) to oil substances when it is heated the rock to about 480□C.
It's kept as reserves until natural oil have been consumed of Earth or when the price of its production is a competitor to production price of natural oil.

Metamorphic rocks

Origin of metamorphic rocks :

Metamorphism of the rock is the change of rocks to new other state if it is subjected to conditions of increasing temperature and pressure so that it requires re-equilibrium and recrystallization to be adapted the new conditions.

Reasons and Places of Metamorphism

1- during mountain building movements (Orogenic Movement)

2- when the rocks are in direct contact or adjacent to the magma of high temperature

3- during movement of two blocks of rocks along faults planes causing friction that causes increase in temperature.

Features of Metamorphism :

The change of its minerals to new minerals.

• The change of its rock texture so that it becomes more crystallized.

• The arrangement of its minerals in perpendicular directions to the direction of the effect of the applied pressure.

Types of metamorphic rocks

1. Massive Metamorphic Rocks :

1) Originated by the effect of temperature when the rock is in direct contact to the magma.

2) The effect of metamorphism decreases gradually away from the contact region

3) The size of the crystals increases forming a massive granulation texture (coarse grain)

1) Marble rocks :

when lime stone is exposed to high temperature where calcite crystals are cemented and compacted together and both hardness and cohesion of marble increases.

2) Quartzite rocks :

When quartz in sandstone changes by the effect of high temperature

2. Foliation Metamorphic Rocks (Effect of temperature and pressure)

The crystals will be arranged in certain directions in the form of flakes or sheets normal to the direction of pressure forming foliated texture

A) Slate ;

when shale is affected by high pressure and relatively low heat. It's used in constructions.

B) Schist rocks (mica schist) ;.

a) Lamination is clear when mica crystals in the muddy rocks will be arranged normal to the pressure direction to decrease the effect of the pressure .

b) It consists of thin sheets similar in mineral components and they're connected not intermittent

C) Gneiss :

a) As a result of increasing temperature and pressure together on granite

b) That leads to the arrangement of the crystals in parallel rows (not connected) and intermittent (cut off lines) .

Metamorphic rocks

Metamorphic rock	Factor of metamorphism	Original rock	Type of rock	texture	mineral
Quartzite	High temperature	Sandy rocks	Massive	Granular	
Marble	High temperature	Limestone	massive	Granular (decoration)	
Slate	Pressure and temperature	Shale	Foliated	Foliated (buildings)	
Mica schist	Pressure and temperature	Muddy rocks	Foliated connected	Foliated	
Gneiss	Pressure and temperature	Granite	Foliated cut off lines	Foliated	

Earth Movements and Continental Drifts

First: Environment and balance of geologic activities

- Through the geological time, the ecologic conditions varied greatly due to variation between water-covered areas and land and changing topographic terrains as well as transition of climatic zones as a result of shifting Earth's poles which affect the living organisms, whether animals or plants.
- The consequent is migrations or accumulation in certain regions of the Earth's surface and scarcity in other regions. The environmental changing is usually accompanied by genetic changes promote, after a long period of time, the appearance of other species more adapted to these new environmental conditions.

Examples of the Ecological Adaptation of Organisms

• The flourishing of the vegetative cover during Carboniferous period (300 million years ago) as a result of warm and moist climatic conditions and plains of organic rich soil needed to plant. These conditions result the accumulation of vegetation organic matter in large quantities buried deep enough and had provided the chance to transform plant residues to coal seams. An example, occurrence of coal seams in Bedaa and Thora area south west Sinai.

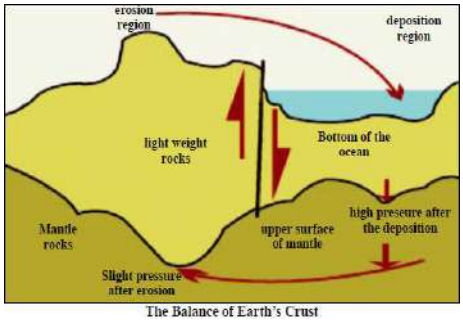
• The rock salts layers (NaCl and others) had accumulated during the Permian period (250 million years ago) occurred in central Europe. These was marked by the spread of depositional basins with great extension and small depth, sometimes intermittently connected with ocean water then separated of it several times, which provided an opportunity to concentration and deposition of salts in the form of layers as a result of evaporation processes for high temperatures under arid climatic conditions.

• An accumulation of phosphate deposits, which consists of marine vertebrate animals remains during the upper Cretaceous period (90 million years ago)was reported in North Africa. These deposits reflected that ordinary temperature and normal salinity prevailed in shallow marine conditions. Examples in Egypt are the phosphate rocks existing near Safaga and Quseir (Red Sea Coast) and in Seba'eya (Nile valley, Upper Egypt) and in Abo Tartur (New valley, Western desert).

• During the Glacial period (since about one million years ago) and the consequent progress of this the ice sheet to south in the northern hemisphere made up glacial periods and was accompanied by periods of heavy rains in southern areas of the northern hemisphere. By retreat of these ice sheets northward during interglacial periods had given rise to environmental conditions as a result of decline and rising sea, affecting the flourishing and intensity of the vegetative cover and consequently the animal groups that feed it during rainy periods. During dry periods, the vegetative cover had been deteriorated, causing decline of animal groups accordingly. These cyclic regimes had been continued since the beginning of the Glacial period and ended more than twenty thousand years ago, where soils and crops improved considerably in the northern areas of the African Great Sahara and resulted in prolific farms for the profits, welfare and civilization of the human being.

The isostatic balance:

The geophysical studies done by professor **Airy** proved that the mountain chains that spread all over the earth's crust which formed of **Sial rocks** those of light rocks of low average density 2.8 gm/cm3 to be in state of equilibrium with the surrounding depressions and plains due to presence of root for these mountains that sink in the mantle of high-density rocks for distances reaches four times its height. This state of equilibrium agrees completely with many of the geological phenomena we have observed due to weathering processes and occurrence of some destructive earthquakes in areas between huge mountains and surrounding depressions. Due to continuous erosion on top of mountains and plateaus, the exposed rocks



The Balance of Earth's Crust

are disintegrated and transported away causing lowering in the weight of these mountains and decreasing the affecting pressure on underneath rock layers. Whereas the pressure increases in areas where fragments are transported due to depositions processes. Consequently, gradual flow of the light molten rock (magma) which is rich in feldspar and quartz forming the granite in upper mantle layers under the deposition areas to the disintegration areas so the mountains rise up and earth crust regain its balance.
A classic example for this balance is the river Nile basin. It is calculated that the Nile carried annually more than 100 million tons of sand, silt and clay during the flood season and built up its delta through the old seven branches (now two branches only Damietta and Rosita). As a result of these tremendous amounts of sediments and their excessive weight and increasing pressure in the delta and its cone which extends northwards for more than 10 kilometers in the Mediterranean Sea, and the present sedimentation south of the High Dam in Aswan, magma flow gradually southwards to compensate what transported of sediments from Abyssinian plateaus and equatorial Africa, thus maintaining the crust in an equilibrium and stable state.

Earth Movements and Their Effects on the Rocks:

During the long history of the Earth (4600 million years), the Earth had been subjected to numerous movements which changed the landmasses, areas of seas and oceans and consequently, the mode of life that existed during the different ages.

The evidences that reflect occurrences of earth movements:

1. The occurrence of marine sedimentary strata, building up the summits of mountains and plateaus, ex. summit of Everest (Himalaya Mountains) at an elevation 8840 meters above sea level and there are rocks like it in the base of the Dead Sea at 762 meters below sea level.
2. The occurrence of coal seams at great depths below sea level.
3. The occurring of phosphate beds above sea level in some regions.
4. The presence fossils of coral reefs in the high places above sea level and it was marine living organisms in the form of colonies on the continental shelf of the coastal region in any warm by high amount of lighting and rich in organic matter.
5. A recent example of earth subsidence, the presence of remains of submerged Roman Temples in Alexandria waters, as well as many villages and coastal surveillance centers in northern delta has been flooded by seawater.

Earth movements are classified into two main categories:

1. Epeirogenic Movements:

This name means that it is a slow movement which acts for a successive geologic time and affects extensive regions of the continent or ocean floor causing gradual uplift or subsidence of the sedimentary sequence without deformation neither by folding nor faulting. The emerged strata appear almost horizontal or in the form of plain folds at high altitude above sea level. This kind of movement plays an important role in distribution and relationship between continents and oceans throughout different geological times.
As an example for this movement is the grand canyon of Colorado River in North America. Here, the Marine sediments remain horizontal on both sides of the canyon attaining an elevation of 1580 m. above sea level same as its original state of deposition. Which signifies that areas of land were uplifted without exposing to deformation during uplifting processes that continued slowly and consecutively for long times.

2. Orogenic Movements:

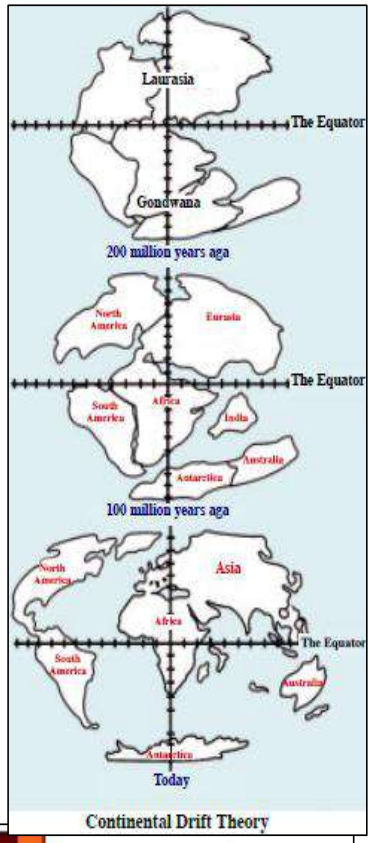
The name is also derived from the Latin origin (Ores = Mountain) and it is relatively rapid movement compared to the Epeirogenic movement. In the meantime, it changes the shape of the strata causing tight folding and intensive faulting through low inclined faults with great side displacements. The effect of this movements usually appears on limited distinction extent for long distances on earth's crust rocks where the deposits accumulates over each other's to occupy small areas after it was flattened on large areas and resulted in chains of mountains in local regions.

The examples are the **Atlas mountain chains** of north Africa, the Alps mountain chains of central Europe and the Himalayas mountain chains and north Egypt, such mountain chains are reported extending from Maghara mountain to Bahariya oasis through the areas of Shabaraweet and Abu Roash.
It is noticed that the magma is extruded through deep seated faults and reaches near the surface where it cools down giving rise to fine crystalline igneous rocks either inter stratified or cutting across the deep and surface rocks. In some instances, the magma reaching the surface forming local volcanoes with lava flows, pluralistic material, volcanic dust and gases. The lava flows along the slops of the volcanic cone.

Continental Drift and Theory of Plate Tectonics

Continental Drift

The great similarity between meanders of the eastern coast lines of both North and South America and meanders of the western coast lines of Europe and Africa gives the idea as if they were one land piece and drifting away from one another. Similarly, the co-relatable criteria of the rocks of these continents and close features of ancient life and distribution of climatic belts on the two opposite sides of the Atlantic Ocean inspired **Alfred Wagener** to introduce his theory which claims that the continents of the Earth where a huge vast landmass (called **Pangaea**) formed of the Sial whose rocks are rich in silica about 70% and aluminum, (hence the name Sial) which is prevailing in the continentals bodies, over Sima (sima which form the ocean beds & extend under sail (continents), whose rocks are less rich in silica about 45% but is the dominant and followed by Magnesium, (hence the name Sima). The rocks of the Sima build up ocean floors and extend under the continents at great depths during Paleozoic era. Pangaea started by the Mesozoic era (since 220 million years ago) to split into pieces far apart from each other and they achieved their present positions as our modern continents by during the Pleistocene time. **Wagener** attributed this slow drift to convection currents of heat in Sima which have enormous capability of folding and faulting the crust causing pronounced difference in the topography particularly on the edges of large continents as North and South America, Africa and Australia where great mountain chains are formed due to continental drift.

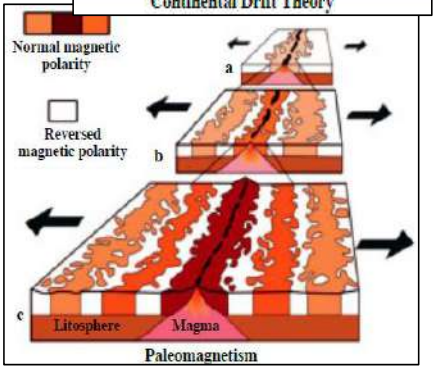


Continental Drift Theory

Evidences supporting theory of continental drift:

(1) Paleomagnetism:

It is the magnetism of rocks that containing magnetized minerals such as iron oxides which affected by Earth's magnetic field during formation of those rocks, where some magnetic minerals in rocks show similarity in the direction and intensity of the magnetic field at their formation, which gives evidence of the old magnetic field of Earth and their behavior in different geological eras. During study of igneous & sedimentary rocks scientist found that the deviation angle of magnetic needle of compass is 90° at pole & 0° at equator.
If a sample of rocks is found with deviation angle of 20° near the pole we conclude that its original position was near to equator and that is an evidence of continental drift different



Paleomagnetism

ages as well as for rocks of the same age in different parts of the world. As well as at the study of mid-ocean ridge shows the similarities of magnetic polarity changes on both sides of the mid-ocean ridge as shown in the figure which indicating the occurrence of continental drift.

(2) Paleoclimate:

The climatic belts are arranged nowadays in a parallel manner extending from East to West. They grade from the equatorial, tropical (desert), and temperate (Pasture and herbs areas) then securities deciduous forests, conifer forests end with the freezing polar climate. And from the study of geological record, we can support the continental drift through:

a) Ancient Evaporites Deposits: Evaporites are salt deposits which accumulated as layers as a result of the evaporation of solutions containing these salts in arid dry climatic regions. Through the study of the ancient evaporites, where currently exists in extremely cold areas of northern hemisphere in northern Europe and Canada.

b) Old coral reefs and coal: From the study of rocks containing coral reefs and coal which exist only in tropical and equatorial environment respectively. The presence of these rocks closer to polar regions today that differ than the environment of formation indicates the continental drift theory.

(3) Late Paleozoic Glaciations:

In the southern hemisphere, Cretaceous outcrops show many striking similarities among the rocks of the various continents from late Paleozoic up to cretaceous. These are recorded in South America, the Falkland Islands, South Africa, India, Australia and Antarctica. This phenomenon reflects the existence of a great southern continent called Gondwanaland. The distribution of ancient glacial deposits on the various southern lands is one of the convincing lines of evidence for continental drift particularly the identical features of the glacial cover in both South America and Africa that indicates that they were one continent that drifted away from each other.

(4) Animals and plant fossils:

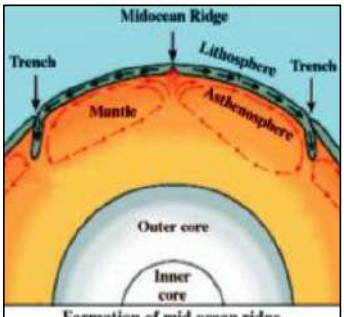
Presence of an assemblage of some reptiles fossils that can't cross the oceans and trapped in the rocks of southern continents only, also the presence of leaves, seeds and fossils of primitive terrestrial plants in southern continents and India, prove that there was a connection between these continents.

(5) Geological structure of the continents:

Furthermore, some anciently formed mountain chains now terminate abruptly at the continental margins. If these continents are joined together, their geologic structures will match up between the landmasses. As an example, is the close similarity between the mountains of south Africa and their counterparts in Argentina to the west Africa and the mountains of Australia to the east Africa and also western African coast with the eastern south American coast.

Plate Tectonics Theory

This theory was proposed by scientists Isaacs , Oliver and Sykes in 1968 followed by a series of studies based on the assumption that the earth surface is made up of a number of large lithospheric plates either oceanic or continental each attaining up to 100 km in thickness. The boundaries of these plates are located at tremendous growing fractures extending for long distances on deep ocean floors or on high mountain chains. These plates are in continuous motion in very slow speed due to the presence of rotational convection current resulting in all massive structural phenomena on earth's crust.



Formation of mid ocean ridge
Plate Tectonic Theory

Reasons of Plate Tectonic Motion

The motion of plate tectonics resulted due to the variation in temperature distribution in mantle which forms rotational convergent currents in magma which exists in the upper layers of mantle. These currents are two kinds, one is moving downward forming the deep trenches and the other is moving upward forming the mid oceanic ridge. Seas and oceans beds are formed of heavy specific gravity basaltic rocks (high density) called Sima whereas continents formed of light specific gravity granitic rocks of (low

density) called Sial, so theses oceanic plates slides under the continental one and then melt in mantle when are driven by convection current. There are three types of motions are divergent, convergent and sliding and we are studying them in detail:

There are three kinds of boundaries movements which are:

1. Divergent boundary motion
2. Convergent boundary motion
3. Transform plate boundary (sliding) motion

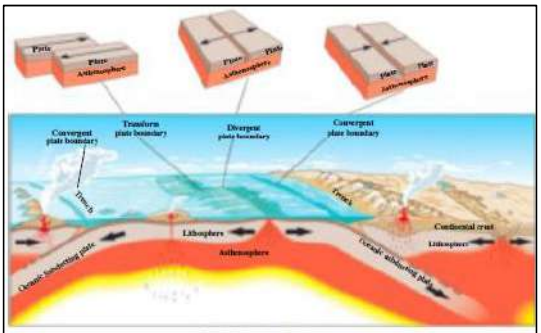
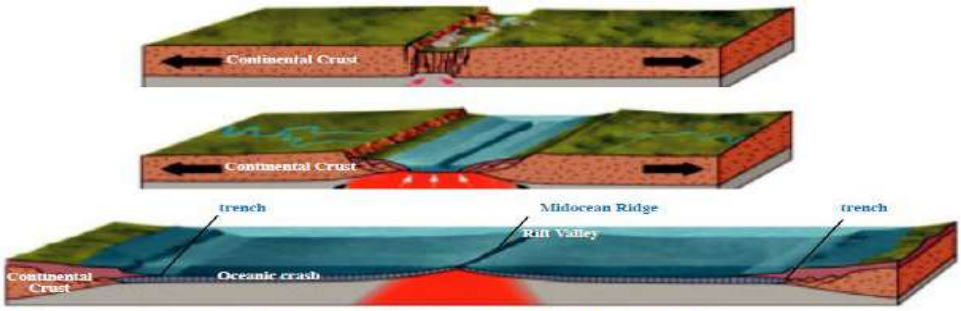


Plate Tectonic Motion

1. Divergent Plate Motion :

Also known as constructive motion, which arise from tension force where two plates move away from each other's as in mid continental drift and red sea where the Arabian plate move apart from the African plate so a new oceanic plate is formed between two continents or between number of continents as in Indian and Atlantic oceans.

The continent would split away and oceanic basin is gradually and very slowly formed. As what happened in Africa continent, where the Red Sea originated and is widening and its sides continue moving apart by a rate of about 2.5 cm per year. The same applies true for Gondwana continent and gave rise to origination of Atlantic and Indian oceans.



Formation of Rift Valley and Mid Ocean Ridge

2. Sliding (Transform) Plate Motion :

Produced as a result of sliding of edge of a plate with edge of other plate forming transforming vertical faults causing fractures or deformations also some volcanoes and earthquakes may be resulted as San Andreas fault and also appears in Aqaba gulf.

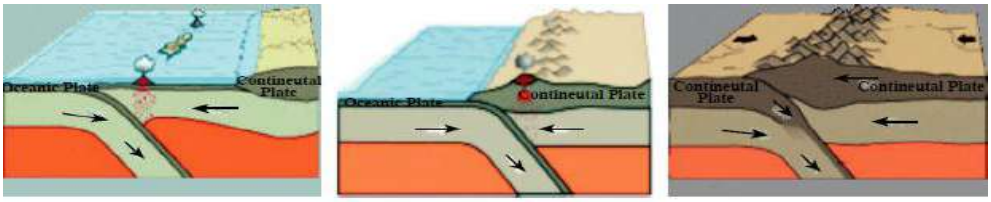
3. Convergent Plate Motion:

Also known as destructive motion, it produced as a result of moving of two plates towards each other where they meet and colloid together. This movement may be between:

A) two continental plates where collision leads to the formation of mountains chains as Himalaya

B) two oceanic plates where one of them slides under the other producing deep oceanic trenches and volcanic island arcs.

C) one oceanic plate and other continental plates where the density of the two plates are differ, the oceanic plate sinks below the continental plate in mantle layer and melts completely forming chain of mountains as Andes mountain in southern America also in Mediterranean sea.



Types of plate Tectonic Motion

Through continuous study and plotting the sites of earthquake foci on the world map, seven large tectonic plates are traced. These are, the African, Eurasian, North American, South American, Pacific, Australian, Antarctic plates, plus a number of smaller ones, and as mentioned before, all are moving slowly.

Earthquakes

Earthquakes is a trapped energy inside the earth's layers which escaped in form of consecutive quick fast shocks (seismic waves) one after the other, occurred on the earth's crust and may cause massive destruction or as weak as to be felt by human.

Types of Earthquakes:

1. Volcanic Earthquakes :

Their occurrences are associated with volcanic activity which indeed are local earthquakes, their impact do not extend in large areas(spread for limited areas).

2. Tectonic Earthquakes:

They occur in areas where the rocks subjected to faulting as a result of the motion of tectonic plates often. They are the most common earthquakes occurrence.

3. Plutonic Earthquakes:

Their foci are found at great depths reaches more than 500 km under the Earth's surface.

The most important reasons of earthquakes :

It is due to breaking of rock masses sudden fractures as result of exposure to intense pressure or tension process which the rocks is not strong enough to bear these forces then broken and liberated the enormous potential energy and turns into kinetic energy. The kinetic energy moves from the earthquake epicenter in the form of seismic waves spread to the vast distances and vibrate the rocks that pass out until reach Earth's surface doing vibration to constructions which leading to their cracking or destruction. Disturbance will be as stronger as possible in the region can be located directly above the earthquake epicenter and this area is known as the epicenter point, and the intensity of the mechanical turbulence decreases quickly away from this point.

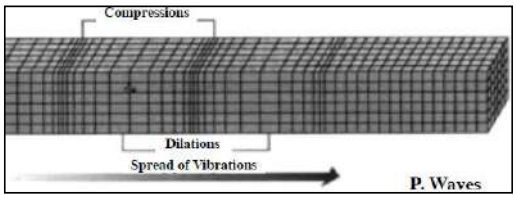
The device used to record earthquake is Seismograph.

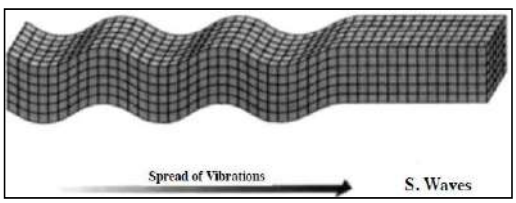
Seismic Waves

First : Internal Body Waves

1. Primary Waves (P-Waves)

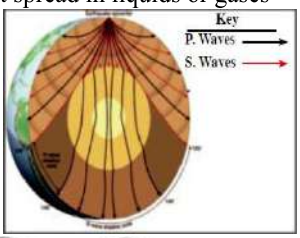
They are longitudinal (primary) waves spread very fast and they are the first to reach the seismic monitoring machines (seismogram). They spreads all over solids, liquids and gaseous bodies.





2. Secondary Waves (S-Waves)

They are transverse (oscillatory) waves of slower primary waves. They can't spread in liquids or gases that means they spread only in solid bodies.

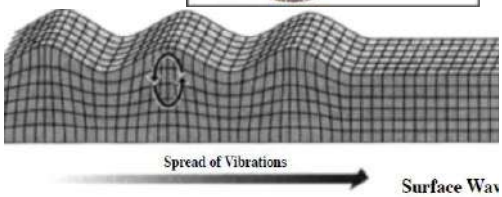


The Importance of Studying Body Waves:

• Through the study of these waves, the scientists discover Earth's interior structure core and can determine the earthquake foci.

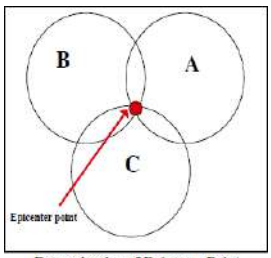
Second: Surface Waves

They are called the long waves and they are complex waves of high frequency that spread near earth's crust. They resulted from the high energy of primary and secondary waves. They are the last waves reaches the seismograms and they are also the cause of mass destruction.



Determination of the Location of Epicenter:

By cooperation between three seismographic stations (A,B and C) each one determine the relative time of the arrival of the three types of waves. By knowing their speed and times of their arrival, so we can determine the distance between station and the surface foci earthquake. Then we draw three circles on a maps, each station represents the center of a circle the point of intersection of these circles is the epicenter point.



Determination of Epicenter Point

Earthquakes Measurements

Measuring the Intensity of Earthquakes:

The intensity is a specific measurement of the damage results by the earthquake beside the reaction of people by it. The most common intensity scale used in US and world is the modified Mercalli scale in 1931. This scale is divided into twelve scales.

Magnitude Scale of Earthquakes:

When comparing quantitatively the earthquake. Charles Richter developed a scale that depends on the amount of energy released. **Richter scale measures the magnitude of the earthquake** (i.e. the total amount of energy released from the earthquake's source). The magnitude of strongest earthquake till now was 9.5 on Richter scale in Chile 1960.

The earth is constantly changing due to different natural factors, which are:

First: external factors:

The external factors include the effect of the atmosphere and hydrosphere in the earth's crust, From the examples of these factors the change in temperature, rain and wind and the resulting of torrential, rivers, lakes, seas, oceans and glaciers, as well as plants and animals.

Second: Internal processes:

These factors resulted from the latent heat of earth's interior, and different internal pressures which cause earthquakes, volcanoes and earth's movements retraction.

Both internal and external factors effect on the earth's shape which resulted in shapes and geological structures which called **Topography**.

External or surface factors

The external factors that cause change the surface of the Earth's crust, The external factors regain its equilibrium through uplifting of great parts from earth's surface due to earth's movement and volcanic activities but if not of these factors the earth's surface becomes flat and free of any topography from long times this surface is called **base level of erosion** and which is the lowest level that constructive factors can be reach in Earth's surface for which the external factors are done to reach it to be equal to sea level.

So **the external processes** have two factors, one is destructive (denudation) and the other is constructive (deposition).

(1) Denudation

It means the effect of the external processes on rocks, fragment it then transport these fragments from its place to expose a new surface of rocks to this process again. This process is called erosion. The transporting agents as (water, wind, torrents and rivers) are transported these fragments to deposit to form layers of sedimentary rocks.

It is divided into three stages:

a) Weathering. b) Erosion and transportation by water, winds. c) Transportation of sediments by gravity.

(a) Weathering:

The end result of weathering of rocks is the fragmentation of rocks into smaller pieces due to mechanical weathering or decomposition of the rocks minerals into new ones by chemical weathering.

Mechanical Weathering

Mechanical weathering is the breakdown of rock masses into smaller fragments of the same mineral composition as the original rock or decomposition of the rock into its constituting minerals. under the effect of physical weathering conditions without change in its chemical or mineral structure. For example, a block of granite, composed of: potash feldspar, mica and quartz. If this block is broken down to pieces in the size of gravel each grain contains the three minerals of granite rock. But if we break it into smaller pieces, each in the size of a sand grain. Each grain will consist only of one mineral only.

Factor of Mechanical weathering:

1. Repeated Freezing and melting of water in rocks fractures

Repeated Freezing and melting of water in rocks' fractures and joints. When water freezes to ice and its volume increases causing pressure on sides of rock fractures and joints and its wide increase and would be separated the block from the mountain. Blocks usually fall and accumulate at the foot of the mountain or cliff and form a **talus slope**.

2. Variation in temperature:

The heat expansion resulted from surface expansion of rock and its mineral structure and contraction due to changes in daily temperature which decrease the coherence forces between the mineral components of

the rocks. This cause its disintegration and the fragmentation of gravels in desert is related to the repeated changes in temperature.

3. The release of pressure due to erosion:

The expansion of rocks due to releasing of load due to erosion. When an appearance of igneous plutonic rocks on the surface that were under high pressure, the rock is expanded due to the releasing of the uploads. This is seen in granites when they become exposed on the surface. The rock surface separates into successive **spheroid shells**. This feature, known as **spheroidal weathering** or **exfoliation**, is aided by the change of feldspar to clay by chemical weathering.

4. The impact of life factors of plants and animals:

We are aware of the impact of life factors in the break up and the dismantling of the outer surface of the land components:

(a) The roots of the plant strike in the soil or rock joints to search for water, making them loose or break down.

(b) The animals and insects are helping to dig the soil and contribute to make it break down and subject to movement with transportation factors.

Chemical weathering

Chemical weathering: is the decomposition of mineralogical components of the rocks to form new minerals as a result of adding new element or more to the chemical composition or by missing some elements that lead to change in the chemical composition. This occurs in the presence of water. The ancient Egyptians was caving the majority of their statues and obelisk that made of granite rock that has strength and resistance to erosion factors impact, especially in Upper Egypt, where the dry air and rare of rainfall that remained statues and obelisks for nearly four thousand years polished smooth. But now if we see one of the obelisks in London, Paris or New York, where rainfall most of the year, we find that the surface of the obelisk is no longer smooth and polish as it was in Egypt but affected under the new climatic conditions and became eroded and dull.

Factors controlling chemical weathering:

(1) Acidic rains:

Water that contains small amount of acidic dissolved matter to form acidic rain. It usually leads to the decomposition and decay of rocks as for example limestone rock is decomposed by completely dissolved under the influence of acidic rains that carry carbon dioxide. This process is called **Carburizing process.**

(2) Oxidation process:

The oxidation process occurred by oxygen dissolved in water especially for minerals that has iron and magnesium in their mineralogical composition as in basalt rock.

(3) Hydration process:

The Hydration process means that addition water to the mineral composition and this process lead to chemical decomposition of rocks. Example **Anhydrite mineral** (anhydrous calcium sulphate) changed to **Gypsum mineral** (Anhydrous calcium sulfate).

(4) The difference between the conditions of formation mineral and the environment of surface conditions:

The chemical weathering lead to change of mineralogical components of rocks to become equilibrium with the new surface conditions. So, we find that the firstly crystallized minerals from magma at high temperature and pressure is more subjected to chemical weathering than those crystallized at the later stages of magma under low temperature and pressure. As mentioned before granite the most common plutonic rocks is composed of three essential minerals: orthoclase (potash feldspar), mica and quartz.

(A) Feldspar minerals (orthoclase and plagioclase) have vitreous luster are very weak under the influence of carbonic acid and it decomposed into new mineral called **Kaolinite** (Aluminum silicate) which has an earthy luster.

(B) Mica mineral also decomposed into **clay minerals** (earthy luster mineral).

(C) Quartz is the last mineral to crystallize from the magma at lower temperature. So, its chemical composition and physical properties make it stable without decomposition.

If we look at the result of chemical weathering process of metamorphic and igneous rocks consisting mostly of silicate minerals represented in feldspars and Mica and others minerals containing iron and magnesium mainly consists of a set of clay minerals found in the agriculture soil mixed with other products of weathering processes.

(B) Transportation and sedimentation:

The processes of transportation occur by factors like wind, rainfall, torrents, rivers, seas and underground water...etc. But these factors have **disintegration** effect on rocks and fragmented the rocks, also these factors are transporting and depositing factors, so they have **deposition** factor also.

Differential Erosion:

Differential erosion happens when one of different transport factors passes or collide with rocks of different hardness and those rocks composed of hard beds overlying softer ones. The soft beds are more fragmented than hard rocks, as in the case of **mushroom shape terraces** by the effect of the wind, **waterfalls and meanders** by effect of rivers, **coastal meanders** by the effect of the waves in the sea.

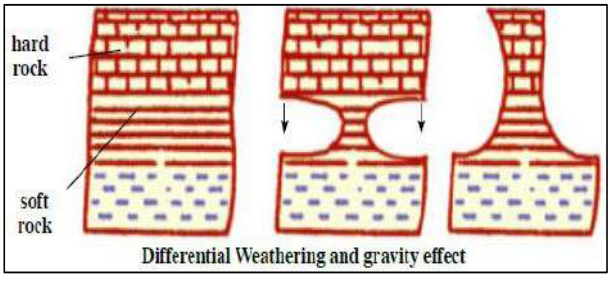
(1) Wind

(A) Disintegration effect of wind:

The effect of wind is differed according to what's the wind carry of sand and fragments of rocks or clay. The load or charge of wind classified into hanging (carried by air) or rolling on the earth's surface. The effect of wind disintegration depends on several factors, including wind intensity, size and shape and density of the granules, rock type and the degree of hardness and their affecting by climatic factors such as humidity, and the effect of the time factor.

(1) Effect of wind as it passed on a different hardness layers:

When the wind loaded with sand pass on heterogeneous or different hardness of rocks include soft layers such as clay rocks topped with solid rock of limestone, which lead to erosion of the soft layers and remaining of hard rock that has dropped by gravity as in the case of mushroom shape **terraces** that's called **differential erosion**.



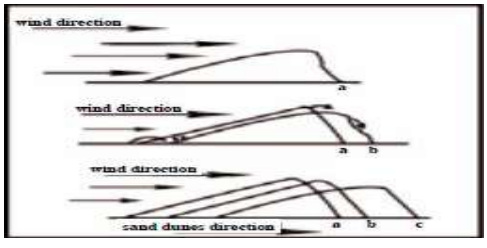
Differential Weathering and gravity effect

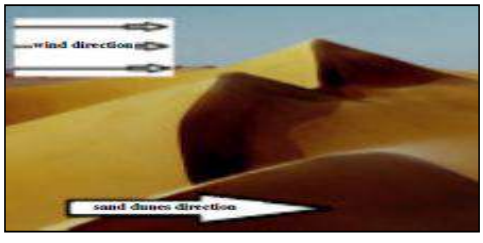
(2) The effect of the wind as it passed on the irregularly shaped stones:

Wind loaded by sand affect the shape of the gravel that has equilateral triangle or a pyramid shape and the front face of gravel will be polished.

(B) Wind as an agent of deposition:

When the velocity of wind that carries sand grains decreases due to its crashed with hard rocks or and the wind will deposit its load in the form of sand dunes or ripple marks.





(1) Sand dunes:

Sand dunes consists of round grains of sand, vary in height from a few meters to tens meters or vary in different shapes including:

A) Rectangular dunes or Longitudinal Dunes:

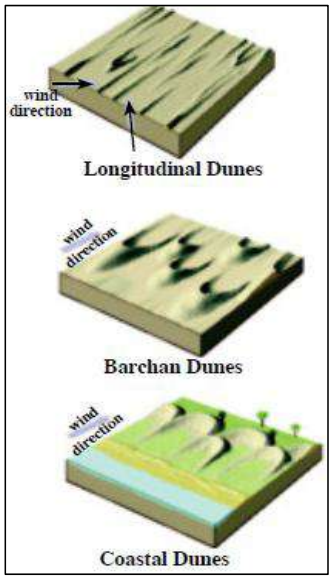
They have rectangular shape and their direction is the direction of the prevailing wind, the rectangular dunes called El-Gharwd. Example Ghawrd Abu El-Mahariq which extends about 300 km from the northwest and to the southeast between Bahrayah oases and El-Kharjah oases in Western desert.

(B) Barchan Dunes: " Crescent dunes"

They take crescent-shaped dunes where Barchan dunes are slight decline in the direction of wind, and very strong decline in the anti-direction of wind, Barchan dunes are the most prevalent types of dunes.

(C) The Coastal Dunes:

They are dunes that consists of consolidated limestone granules such as dunes that extended along the coast between Alexandria and Marsa Matrouh.



Notes: We also notes that the sand dunes have been moved by the wind and the rate of moving reach between five and eight meters on average in the year. This led to the phenomena of desertification causes a great risk to the reclaimed areas and new urban communities.

(2) Rains:

Rain has disintegration effect only. While its sedimentation effect it will be referred to the subject of rivers and ground water.

The disintegration effect of rain is divided into:

(A) Disintegration (degradation) mechanical effect:

Where strong winds accompanied with rain helps to transfer the fragmented or disintegrate another part, for example carving of limestone rocks surfaces due to rainfall to form a set of grooves including low-rise grove as it is the case in the Sinai Peninsula.

(B) Degradation chemical effect:

Where rainwater effect, including rains dissolved with oxygen and carbon dioxide activate the process of oxidation and carbonization.

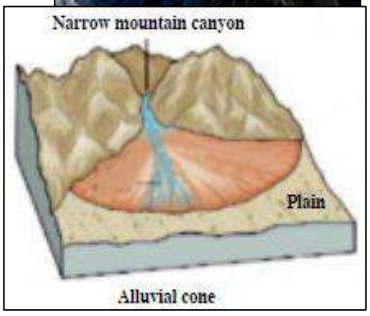
(3) Torrents

Definition of torrents :

When heavy rain is falling over the highlands and mountains, water descend into narrow streams communicate with each made up the so-called El-Akhoor (torrents streams) where torrent growing and increase in its size and speed until it reaches the river or the sea. The torrents have **degradation** and deposition (sedimentation) effect.

Torrents as an agent of degradation:

Torrents carry all fragmented rocks like clay, sand and gravel and this helps to sculpt and the stream torrents that is narrow but with the passage of time is increasing its depth and the work of torrents shows clear in the desert due to the scarcity of the plants.



Torrents as an agent of deposition:

When the speed of torrents decreases, they deposit the carrying materials and the shape of deposit materials takes several forms:

(a) Alluvial cone (Alluvial Fan):
The Sedimentation take form of a half circle position, its center the outlet of the canyon (Akhwar).

(b) Dry Delta:
If the sedimentation begins with boulders and large gravel granules at the outlet area of the canyon and there is gradually decreasing in grain size of the gravel until it is finished with sediments of mud and sand at the end of the dry deposition is called **Dry Delta**.

(4) Rivers:

River has a strong gradient at its upstream and it has a little gradient at the mouth of rivers.

(a) Rivers as an agent of degradation:
Rivers are considered the most important factors of erosion and for the transfer of rock fragments of different sizes on the surface of the earth's crust. The degradation effect of rivers depend on several factors, including:

(1) Speed of the current water and the river load: the amount of material or sediments that river transfer them depend on:

• The capacity of river to carry sediments that depend on the slope of the river that controls the speed of the water and the amount of water in the river.

• Size and quantity of particles depends on the ability of the river to carry sediments where the size of sediments is increasing as the ability of the river to carry sediments increased.

The load of the river is:

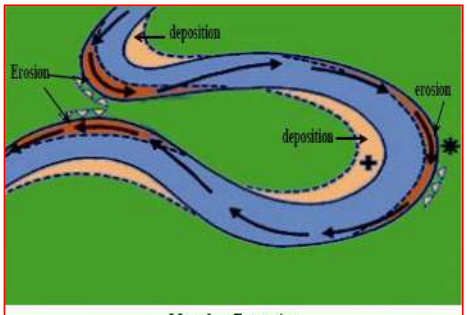
(a) Dissolved load: soluble salts such as sodium chloride.

(b) Suspended load: small grained size and light weight of the mud (silt and clay) move as suspended materials or grains in the water.

(c) Medium size grains of sand: going hanging near the bottom in the direction of the water current then roll on the bottom when the capacity of the river decreases.

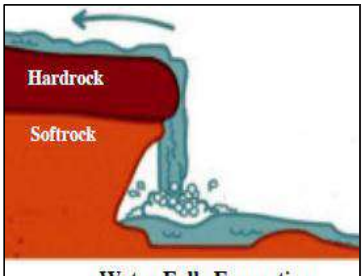
(d) Bottom load: gravel granules roll on the bottom of the river in the direction of the water current, as well as we see those sliding blocks smoothing and become a round faceted as a result of friction with the bottom. **The load help to increase the depth and breadth (width) of the river**.

(2) The different hardness of rocks on both sides of the river:
The difference in hardness of rock layers between soft and hard in both two sides of river lead to erosion in one side more than the other side, which leads to the formation of **River Meanders or Meanders** as an example of **differential erosion** after then the stage of increasing the curvature of the river occurred where increases in the erosion the outer side of the path of the water and increase of the sedimentation in the inner side of the river that side cut a new path, leaving the arc on the shape of **Oxbow Lake**. Thus, the turning of **Meanders to Oxbow Lake** considered as degradation and sedimentation effect of rivers.



Meanders Formation

(3) Different hardness of rocks at the bottom of the river:
Water Falls are formed when the water passing over rocky layers of different hardness, where the solid layer above the soft layer, the soft layer will be sharpener (erode). The hard layer will be steep slope and high in elevation, so it's a normal watershed like differential erosion (Such as Niagara Falls between Canada and the United States).



Water Falls Formation

(4) Climate: The climate has a role in the shape of water stream of the river:

(a) If the climate was humid in the heavy rainfall areas it helps other erosion factors like decomposition of various operations as gravity are also working on the erosion of groove lead to **the widening of river stream**.

(b) In the dry areas, the river is stronger so it keeps its load and erodes **deeply carved river**, as the case in the Colorado River in America.

(b) The deposition (sedimentation) effect of the river:

The sedimentation effect of river starts by several factors:

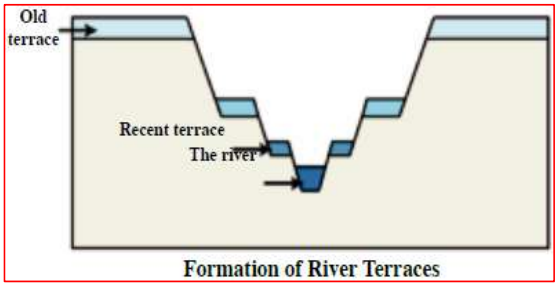
(1) Current speed of water: When the speed of current water of the river is decrease due to the presence of obstructions in the water stream, or decreasing the slope of stream, as in the areas of downstream, where the river loses the ability to transfer its load which lead to deposit of its load.

(2) Volume of water: The lack of volume of water in the river as a result of increasing evaporation or leak of water in the porous rocks or cracks inside the earth.

(3) The downstream of river in static water:

Formation of river terraces:

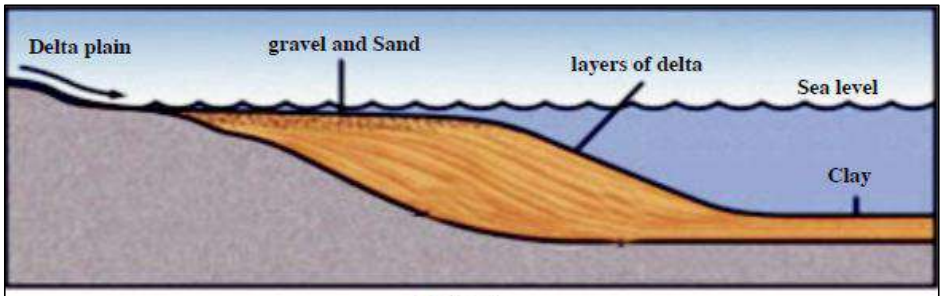
River terraces are formed due to change of water level at the time of flood, and notes that the gravel and boulders materials are found in the high valley area and in the middle of the stream and on both sides of the valley, and so with the water level change, so terraces of the river are formed. Note that the upper terraces are older than beneath terraces on the river. We can see these terraces on both sides of the River Nile in Upper Egypt, as well as Wadi Feeran the way to St. Catherine's in the Sinai.



Formation of River Terraces

Delta:

Delta similar as ***Latin*** letter (Δ), Delta is formed when rivers joined with seas and lakes, the load of sediments that the river carry will be deposited, In order to be Delta formed it is necessary the sea is free of sea currents. When the sea has strong currents, and the bottom of the sea tends to drop and there is no Delta in this case but the river will be normal downstream only because the strong sea currents sweep the sediments that formed by the river. The river in the area of Delta plain may be branched into two branches or more as in the Delta of ***River Nile***, in the past the River Nile branched into seven branches, all of them were downstream in the sea and then disappeared gradually these branches including the sediments where the river deposited it, now only remains Rashid and Damietta.



Delta Cone

It should be noted that the coastal delta deposits are deltaic sediments extend more than ten kilometers within the Mediterranean Sea, the so-called **Nile Delta Cone**. These sediments are classified and graded deposits with increasing depth of the sand and gravels near the beach, then silt and clay in the deeper areas. It is containing mineral deposits of economic value, such as gold and diamonds and tin and limonite that's called **Black Sand.**

Black Sand in Egypt on the coast from Rashid and Arish east and containing minerals of **Monazite** (containing **radioactive uranium**) **Ilmenite and zircon** (mineral of zirconium element) which are used in **Ceramics industry**.

Action of the river at different stages:

Each river has a cycle includes various changes in the river, include several stages are:

(1) Youth stage:

This stage characterized by valleys and branches, the river is characterized by the fast stream, irregular slope and erosion increases and less of sedimentation, which leads to the formation of lakes and waterfalls, wide of grooves. The sector V-shaped narrow and this stage also characterized by appearance of **River Capture**, which arise from the disparity of branches in erosion and thus the water level of the section with more erosion less in the level of the other branch and is down stream of it. At the end of this stage, it becomes a steep slope of the river.

(2) Maturity stage:

The valley expands to the fullest extent and its sector becomes V wide shaped. Both of erosion and sedimentation almost equal and there is increase of meandering of river, also increasing of Oxbow lakes and waterfalls disappear.

(3) Old stage:

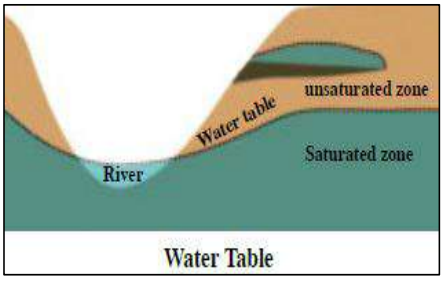
In this stage the river characterized by low gradient which led to decrease the erosion effect and increase of sedimentation and the area of river stream is called the peneplane, the river called an old stage and a sector of the river like ◡ shape of an arc and the curvature of the river decreases at the downstream area.

(4) Rejuvenation (Re-youth) stage:

There are geological factors lead to the river return to Rejuvenation (Re-youth) stage after it reached to an old stage that was occurred when tectonic movement arising takes place near the upstream area or volcanic eruption objected the river stream thus the speed of the river was increasing and the river begins to new erosion in its stream. Again, the river begins to deepen its stream while lateral erosion and corrosion or stop finally.

(5) Underground Water:

It is the water in the pores of the rocks under the surface of the earth and its source is rainwater or ice that seep into the ground through the pores of the rocks or cracks, gaps and joints. Some of this water is rising to the surface by capillary action or by absorption by plant roots. The level of the soil water is called **water table** which is a water level that all the pores below, cracks and spaces are saturated with water and the depth of this level it differs: it's near the surface of the sea, rivers and places of rain and far from the surface in dry areas.



Movement of ground water:

Ground water is in a permanent movement and there are several factors controlling the movement of ground water including:

(1) Rock type: include the size, shape, and the cement materials of the grains.

(2) The porosity of rocks:

Porosity is the percentage of pores, cracks and spaces between the rocks and grains.

Permeability of the rock: is the ability of the rock to pass water through the pores of the rock or how easy is the movement of water through the rock pores. (Porous Sedimentary rocks such as sandstone, sand and limestone are the best reservoir rocks to store groundwater, oil and natural gas).

(3) The general inclination of the layers that containing ground water.

(4) Different geological structure such as folds and faults, joints, dykes and sills.

Geological effect of ground water:

1. Degradation effect of ground water

(a) Chemical degradation effect of ground water:

- The chemical degradation effect of ground water due to presence of carbon dioxide gas and acidic salts dissolved in water whose lead to dissolving of limestone rocks that lead to **formation of caves**.
- Also, alkaline water or water mixed with organic acid lead to dissolve of silica that replacement the calcic components of fossils or replacement the organic fibers of trees to form **petrified woods** (**Fossilized trees**)

(b) Mechanical degradation effect of ground water:

Mechanical degradation effect of ground water occurred due to saturation of porous rocks with ground water which leads to blocks of rocks to fall on the mountain foothill.


Stalactites and Stalagmites

2. Sedimentation effect of ground water :

(a) As a result of the dissolving of the limestone rocks by ground water that carries carbon dioxide, these solutions deposited inside caves and caverns to form:

- **Stalactites:** deposits of calcareous materials hanging from the ceiling of the cave.
- **Stalagmites:** deposits of calcareous materials grow from the floor of the cave.

(b) Replacement of the silica by the limestone materials in the formation of fossils and place of fiber in the formation of Petrified trees and so this process is the work of degradation and sedimentation.

(6) Seas and Oceans

Seas and oceans affect everything that surround them from the earth's crust by continuous motion of that causing tidal waves as well as tide and ebb and ocean currents and the influence of the seas in the degradation process that less than sedimentation process.

(a) Degradation effect of seas and oceans:

The degradation effect of seas and oceans depend on:

(1) Movement of the waves: the waves arise as a result of wind blowing in a certain direction and the degradation effect of waves different according to the power of the wind and its direction. The effect of these waves is strongest when they are loaded with rock fragments that transferred to it, also **waves lead to erosion of the beaches** and transferring these fragments to the deep water of the sea or parallel to the coast to deposit in other areas and thus waves act as **erosion factor** and **deposition factor**.

(2) Difference in the hardness of the rocks: as the degree of rocks resistance vary based on the kind of rocks where soft layers of rocks eroded and hard layers remain prominent. So, meanders, gulfs and coastal caves are formed.

(3) Tide and ebb: Tide and ebb like waves help on carry fragments of rocks away from the beach and as a result **Stairs Samples graded fragments** are formed and these use as indicator of the water level at the time of the tide and ebb.

(4) Ocean (sea) currents: ocean currents formed by changing the density of the water by changing temperature, as well as change the degree of salinity of water as a result of a difference in the evaporation rate, so cliffs are formed as a result of the marine erosion on the coast or costal caves and gulfs (bays).

(b) Deposition (Sedimentation) effect of seas and oceans:

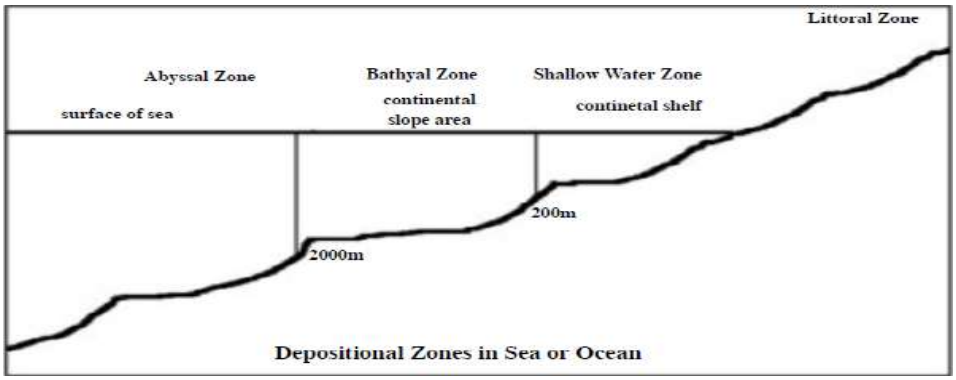
Sedimentation in the seas and oceans include all fragments of rocks that transfer by rivers, wind. So, we find the deposition takes place at different depths and these are the areas:

(1) Littoral Zone (Beach area):

The boulders, gravel and coarse grains sand are accumulated and affected by the movement of tides also arise of **spits and barrier.**

Spit is an elongate ridge of deposit at sea area due to meeting of two streams are moving in opposite direction, so sand will deposit at the line of friction between them, spit may be formed at the downstream of the river like spits that extend north of **Manzala Lake.**

The barriers are spits at the bays area and it may plug (close) them to form a marine part semi-closed on the form of a lake like **Mariot and Edco Lakes**.



Depositional Zones in Sea or Ocean

(2)

Shallow Water Zone (Continental Shelf):

It's the area that extends from the beach to a depth of 200 meters, it's characterized by flourish life, its water affected by the temperature of the atmosphere and sunlight. The sediments are gravel and sand near the beach area and mud towards the inside except lime deposits that resulting from the accumulation of oyster's animals after their death.

(3) Bathyal Zone (Continental Slope area):

It's the continental slope area, its depth ranges from 200 to almost 2,000 meters, the bottom area of this zone is quiet, low temperature area, the light didn't pass to the bottom area, the sediments of this zone are fine grained organic calcareous silicic sediments, and it is primitive remains such as **foraminifera, diatoms and radiolarian**.

(4) Abyssal Zone:

It's the area at great depths deeper than 2,000 meters and it's characterized by constant temperature almost close to 0°C. It's sediments free from rock fragments that transmitted by wind and rivers. The sediments containing red clay, which are of volcanic deposits, and also contains fine grains organic sediments of limestone and silicic deposits that are remains of micro-organisms like **foraminifera and diatoms**.

(7) Lakes

Lakes are the basins of fresh or saline (salt) water and it often disappeared as a result of water evaporation or due more sedimentation or passing through the rocks pores.

Lakes arise near the shores of the sea as a result of grow of coral reefs or deposition of barriers that closed bays. Or arise on land as a result of sea regression or drop of sea water, then turned river stream and torrents to the sea, lakes arise also in the craters of volcanoes which subsided then filled with rain water and torrents.

Lakes deposits divided into:

(1) **Saline lake sediments**: include gypsum and halite like Edco Lake, or sodium carbonate and magnesium carbonate as in the Wadi El-Natron lakes.

(2) **Freshwater lake sediments**: include gravel and sand near the beach lake and fine grains of clay in the middle of the lake beside and freshwater snails.

(8) The Soil and Their Components:

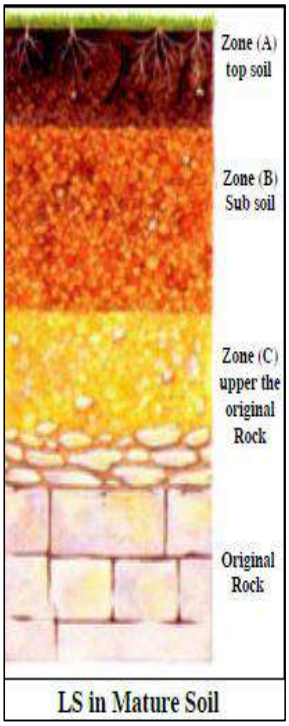
Soil usually consists of a mixture of mineral materials and the remains of decomposing organic materials and some fluids, gases and remains of living organisms. Soil arises from fragmentation of the surface rocks and erosion by weathering factors and the influence of different living organisms.

The thickness of the soil depends on:

• Chemical composition and physical properties of the original rocks.
• The strength effect of different climate factors.
• The impact of living organisms.
• The time factor.

Soil has many benefits:

- It's appropriate layer for the growth of plants.
- Soil store and purify the groundwater.
- Soil is a suitable medium for decomposition of dead organisms.
- Soil is a suitable for life of many living organisms and insects.



LS in Mature Soil

Mature soil:

The mature soil was formed of three main parts:

Horizon (A) Topsoil:

This zone is characterized by an abundance of organic matter that resulting from the decomposition of living organisms.

Horizon (B) Subsoil:

It's characterized by being oxidized and it may contain a secondary deposits of sand and silt mixed with some mineral deposits, which deposited from the above soil.

Horizon (C) upper the original rock:

This zone is characterized by a little change from the original rock area and it is composed of coherent rocky material or fragmented formed the soil and plant roots do not penetrate this layer.

Types of Soils:

(1) Residual Soil:

- It's formed in its place consist of the same bottom rock.
- It's characterized as being very similar the original rock, which is located above it in the chemical composition and differ of the degree of similarity by differing the influence type of atmosphere.
- It's characterized by gradually texture grains size until it reaches the original rock. For example, we find the original rock topped by a cracking zone and sharp edged boulders then sharp edges grains then we find rough soil then surface soft soil.

(2) Transported soil:

- It's the soil that disintegrated in its place then transferred to its current place.
- It's different in most cases from the lower rock in chemical and mineralogical composition, so we find sometimes clay soil above sandstone rock, or sandy soil above limestone rock.
- It's differed in the texture there are rounded angled pebbles.
- This soil always exposed to erosion and various transport factors.

The Concept of Environment

Environment is everything around man (living and nonliving components) that affects him and is affected by him.

The concept of environment includes several physical, chemical, biological, social, cultural, economic and political aspects which interact with each other.

It includes three main components:

1- **Natural environment** (which he shares with other living organisms.

2- **Social environment** which man shares with other people (It includes the establishments that man had created to organize the relationships between community members and those establishments).

3- **Technological environment** (which he made by his knowledge and Progress).

The concept of the environment is not restricted to the local environment only, but it is broadened to include the local environment, and the whole universe.

Ecology science studies the structure and function of nature, i.e. What determines life and how the living organisms use what is available to him where he lives. On the other hand,

Environmental science deals with the interaction between life and the components of the environment. This means that it deals with the application of information from different fields of study such as physical, chemical, biological, social and economic.

1- It takes care of the preservation of the environment,

2-its good management and preventing its destruction.

3- It also deals with the protection of the populations from the adverse effects that may occur naturally or due to the unwise use of man.

The biosphere is the area where life exists.

It includes life deep in the oceans, on the surface of the Earth and the tops of mountains.

* Its maximum thickness does not exceed 14 km.

The unit of structure of the biosphere is the **ecosystem**.

The forest, the desert, the oases, the river, the sea.... etc.

The word ecosystem was introduced to describe all the living organisms and the nonliving matter in a certain area of nature and the interaction between the living and nonliving components.

The biosphere includes geological structures, water phenomena and biological components which man makes use of this passes in three steps:

The first step: man discovers the usefulness of the thing.

The second step: he develops the means (the technology).

The third step: man starts to work to get this thing and transform it into a permanent resource, i.e. continuous wealth.

It is very important to study the ecosystems and its relationship with man as our lives depend on the safety of these systems.

Characteristics of the ecosystem:

First: Multiple Components:

The ecosystem is composed of nonliving components that determine the kind of life that exist in the ecosystem and living components so there are two kinds of factors:

1. Non-living Factors (nonliving)

These include the following:

A. Physical factors	B. Chemical factors
The factors of climate as temperature, light, wind, location relative to the sea surface and latitude.... etc.	The factors that deal with the chemical side as the effect of the increase or decrease in some elements and chemical components, the acidity and alkalinity and the soil salts... etc.

2. Living Factors:

These include all the living organisms in the ecosystem and their effects on each other and on the environment. It is noticed that the living organisms in any ecosystem include three groups of organisms these are:

A. Producers:	B. Consumers:
These are the green plants that convert the solar radiant energy into chemical energy stored in the food through the process of photosynthesis..	These are the animals that depend on green plants for their food. Some of them feed directly on the plants (herbivores) and some feed on animals that fed on plants (carnivores).
C. Decomposers:	
These are microscopic organisms that feed on dead plants and animal bodies. It decomposes their bodies extracting energy from it and leaving minerals and other components that go to the soil. Examples the saprophytic bacteria and fungi. These represent the guard in nature. Without these organisms every dead organism will remain in the place where it died and the elements of carbon, phosphorus and nitrogen and others will stay in these dead bodies. The decomposers are the organisms that liberate the compounds of these elements from the dead bodies to the soil where they are reused thus ensuring the continuity of life in the ecosystem.	

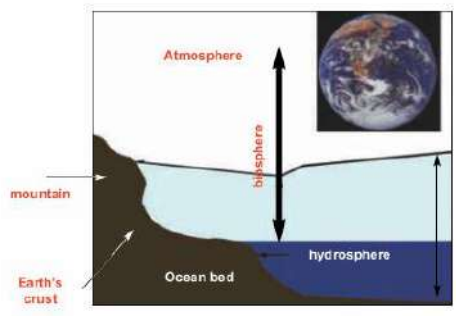
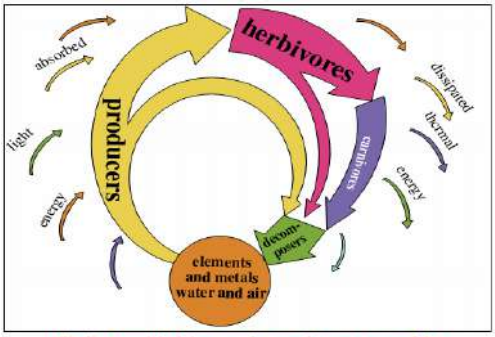


Fig (1) Planet Earth.
The biosphere and its relations with other spheres



(Fig.2) A model of the organisms and components of the ecosystem and its relationship with the flow of energy and cycling of matter

Second: Intricate Relationships:
Any ecosystem is complicated to a certain degree. This is because of its components: physical, chemical and living and its mutual intricate relationships between these organisms on one side and between them and the nonliving factors on the other hand. This means the presence of a food web in the ecosystem.
Third: stability With the Ability to Change:
The stability of the ecosystem means its ability to return to it original situation after any change it is subjected to, without occurrence of a basic change in its construction. Ecosystems tend to be stable as the diversity of species in it increases the mutual relationship among them and thus increasing the stability of the ecosystem i.e. the natural biological balance inside it.
Fourth: Using Wastes:
One of the characteristics of the ecosystem is that it uses its wastes. If we take the marine ecosystem as an example, we will find that fish excretes nitrogenous wastes used as food by the algae on which fish feed. Thus, these wastes do not stay in the sea water keeping its characteristics. Also, living marine organisms produce carbon dioxide in its respiration. This is used by the marine plants in the process of photosynthesis which produces - in addition to the organic substances-the oxygen necessary for respiration. Thus, the ratio of the two gases remains constant in the water.

1- light and its environmental effect:
Sun is the source of light and heat. Light is the visible part from the solar energy. and it is from the most important factors affecting plants and animals as will be seen in the following.
a- Light and photosynthesis:
Photosynthesis in green plants will not happen in the absence of light. In the presence of light, chlorophyll absorbs the wavelengths between 390 and 780 nanometer (the nanometer = 10-9 meter) where the chloroplasts carry out food production. In this process, light energy is converted into chemical energy. This chemical energy is the source of food necessary for providing energy for the consumers and the decomposers.
b- Light and tropism:
Tropism is the localized movement (without movement of the body) due to growth in a direction determined by the direction of the external stimulus to the plant. If the direction of growth is towards the stimulus, the tropism is positive. But if the growth is in a direction opposite to the direction of the stimulus, i.e. far away from it, the tropism is negative. You already known, that the plant stem is positively phototropic. This tropism is due to the elongation of the stem cells far away from the light more than cells that face the light. This is because plant cells respond to growth regulators (auxins) in the dark more than in the light.
c- Light and flowering in plants:
During its growth, the plant passes through two stages. Vegetative growth stage and the flowering and fruiting stage. In the first stage the embryo cells divide during seed germination where the root, stem and leaves are formed. In the flowering and fruiting stage which starts after a period of vegetative growth, the plant forms these flowers and fruits due to many internal reactions. These two stages are affected by the factors of the ecosystem. These factors may be favorable for the two stages or may be favorable for the vegetative growth only.
plants are divided into:
1- plants that need long light period followed by short dark period (long day plants),
2- plants that need the reverse conditions (short day plants)
3- plants which are not affected by the sequential light and dark periods.

d. The light and the distribution of the living organisms:
Light is one of the important factors in the distribution of living d. The light and the distribution of the living organisms:

Light is one of the important factors in the distribution of living organisms in water and land. In the water, the depth to which the light reaches determines the presence of certain kinds of organisms. Algae, for example, differ among themselves in their needs for the kind and amount of light necessary for photosynthesis.

Red algae, for example, need relatively small amount of light; therefore, it can manufacture its food at a 25 meter deep.

Brown algae cannot make its food at depths more than 15 meters.

The algae that can fix itself at the bottom, can grow at 120 meters deep, whereas **vascular plants** cannot live in fresh water at depths more than 10 meters.

e. The light and the animal's activity:

Sunlight has a pronounced effect on the activity of animals. This activity can be divided to four photoperiods during the day. These are:

- **The dawn period**: In this period the activity of the night animals is reduced gradually. Then the animals go to their homes.
- **The day period**: In this period, the day animals become active.
- **The sunset period**: In this period, the activity of the day animals is reduced gradually. Then the animals go to their homes.
- **The night period**: in this period, the night animals are active.

Besides, the moon light has a pronounced effect on animals living on the sea shores which are exposed to the tide. Some of the animals that become submerged by the flow tide remain inactive when the tide water is ebb tide.

f. Light and the animal's migration:

Migration is a biological periodic phenomenon. It occurs by the movement of certain animal population during certain times or seasons.

Daily migration

- **the birds** that migrate daily to its feeding place and return to its nest.
- **The living plankton** move up to the surface or descend to the sea floor daily.
- **The roaming Crustaceans** for example, are affected by ultraviolet light, thus it keeps all day under a depth of about 27 meters and migrate to the surface during the night.
- **Some fishes** leave the deep to the shallow waters to lay eggs during night and return to the deep waters during the day.

the seasonal migration

- Desert reptiles which are grouped in long tunnels under the ground in winter and gets out of it in the spring season and goes back to it the following winter. - The length of the day time (its increase in spring and its shortness in autumn) is an important factor in triggering migration in a regular periodical way. It was proved that the day length affects the activity of birds which in turn affects the size of the sexual glands which increase by increasing the day length and decrease by its decrease.

2- Temperature and its Environmental Effect:

These activities are clearly affected if the temperature is less than zero or higher than 50^{o} C. When the temperature becomes somewhat unsuitable in the medium where the organism lives either by increase or decrease, it goes to dormancy. This is very obvious in spore formation in bacteria and cyst formation in protozoa. Some animals such as amphibians and reptiles revert to **hibernation** where the temperature of the medium where it lives is decreased. Other animals such as molluscs and insects where they are subjected to higher temperature, they revert to what is known as **summer laziness**.

1- THE MARINE ECOSYSTEM

The water of seas, oceans and bays covers about 72% of the earth's surface in what is known as the hydrosphere and it constitute a suitable medium for the growth of many plants, animals and microorganisms.

Due to the continuity of the water of the seas and oceans, it constitutes a relatively stable environment compared to the terrestrial environments which vary in their - physical, chemical, and biological conditions due to the separation of the earth into continents and far away islands.

Non living factors:

a- The salt content:

The concentration of the salts dissolved in the sea water varies according to the quantity of rain or falling water from river mouths of polar refrigerators and the extent of evaporation due to the prevailing temperature. The average concentration of sea waters is 35 gm/liter.

- The degree of saltiness is increased to 40gm/liter or more as it is the case in the Red Sea and the Arabian gulf. This is due to the increased evaporation, and the reduction in rain or river mouths.
- The salt concentration decreases in some seas to reach 20 gm/liter or less as is the case in the North and Baltic Seas due to the reduction in evaporation and the increase in rain and the number of rivers. Thus, the concentration of the salts dissolved in sea water varies according to the climatic conditions.

b- The temperatures:

The water temperatures is around 30^{o} C in the warm seas near the equator and decreases gradually as we move north or south until it reaches the freezing temperature at the poles .

The water temperature also decreases gradually from the surface to the bottom where it reaches 2^{o}C or less at the floor of the deep seas and it stays without change all the time. On the other hand, the temperature of the surface water changes according to the season, atmospheric changes, and the different atmospheric conditions. Sea waters store large quantities of heat which it absorbs from the sun-rays during the day and it leaks it at night to the space and the surrounding earth. This provides warmth to the coastal areas which are characterized by heat stability which is more than the tropical areas far away from the seas in which the temperature varies day and night and in the different seasons.

c- Light intensity:

Light intensity in the seas depends on the quantity of light that penetrates the sea water. Some of this light is reflected, another part is absorbed and the rest passes according to the wave length to certain depth. The red long waved light passes through the upper layers of water whereas the short waved blue and violet lights penetrate the deeper water (the blue colour of the sea is due to these light waves).

Thus the surface waters are well illuminated at about 200 meters deep whereas the illumination decreases until nearly 500 meters, then illumination disappears after that until darkness prevails in the rest of the water column. The light which passes through the surface sea water plays an important role in the plant life which depends on it for carrying out photosynthesis, so it is present where light is found and disappears completely from the dark water. This also affects the distribution of the other living organisms which depend on these plants for their food.

d- The water depth:

The depth of the sea water varies from few meters at the shores and bays to ten kilometers or more in some oceans where deep canyons are found. But ordinary seas such as the Mediterranean, has a depth which reaches about 4000 meters whereas the red see does not exceed 2500 meters in depth. The Arabian gulf does not exceed 80 meters in its deepest parts.

e- The water pressure:

The pressure of the water column increases by one atmospheric pressure for every ten meters under the water in addition to the atmospheric pressure at the sea level. If a person wants to live in the sea to a depth of 20 meters for example, he will be exposed to a pressure which equals 3 times the atmospheric pressure. If he dived to meters deep, he will be exposed to 11 atmospheric pressures and this is impossible to

endure without the diving equipment. But the animals that live in the deep seas have bodies and physiological characteristic that enable them to bear this high pressure in addition to the ability to live in the conditions of deep waters as severe cold and complete darkness.

f- The water movement:

The water movement is affected by the wind direction, the tide and the location of the coast with respect to water falls and river mouths. In some seas, huge water currents are generated with specific routs directed by the earth rotation, temperature and water density. This affects the distribution of the marine organisms.

g- The abundance of food:

In the surface waters, phosphate and nitrate salts are found which help in the formation of protein in the cells of marine plants which help in the growth and reproduction of these plants. These element cycles between the living organisms and the water in regular cycles start with the liberation of these elements from the bodies of the living organism after their death and precipitation in the depth. As the water is moving and have upward currents of the plant life in the top water layers, and thus the animals that feed on them increase and fish is increased accordingly. Thus, the abundance of nutrients in any marine area is an indicator of the increase of fish production in it.

Marine Food Chains:

Plankton, there is a large group of protozoa, worms, small crustaceans, and different larvae which all feed on the phytoplankton found near it in the surface waters. This is considered the second trophic level in the marine food chain.

The third trophic level includes several small fishes, crustaceans, and molluscs, The forth trophic is the big fishes that feed on the crustaceans and the small fishes. The fifth trophic larger fishes such as the sharks and marine mammals such as seals and dolphins and they share this level with marine birds such as seagulls, penguins and hawks.

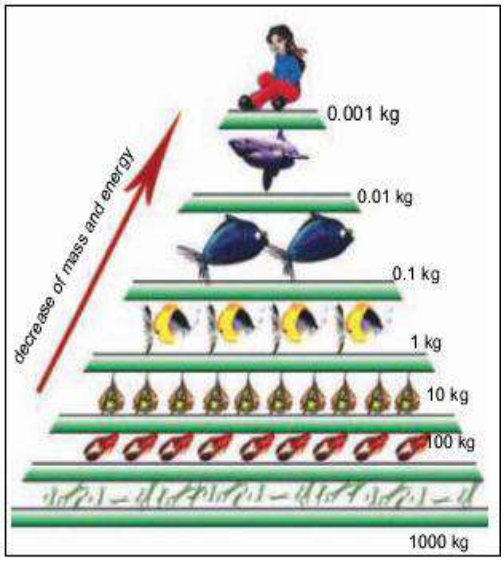
Finally come the large whales that feed on what it can get from these forms.

The man is on the top of the marine food pyramid as he catches different fishes, sharks and whales.

Characteristics of Marine food chain:

Most of the marine organisms are carnivores except few herbivores found among the plankton, fishes and molluscs. Thus, marine life is characterized by its long food chains and the multiplicity of its trophic levels, this leads to the loss of a big ratio of energy lost during its passage from one trophic level to the other.

Scientists have estimated the loss of energy on moving fro m one trophic level to the other to be about one tenth. Thus, if we started with a number of phytoplankton that weight 1000 kilograms (on the assumption that it produces a certain quantity of heat calories), 100 kilograms only of it will move to the following trophic level in the zoo plankton. It will become 10kg in small fishes, it will become 1 kg in big fishes, it will become 0.1 in shark and 0.01 in whale and finally, it will be 0.001 kg in man if he fed on these forms.



In order to make good use of the productivity power of the seas, we should depend on the first trophic level in the chain and not on the second or the last. Thus, research is going on to develop the phytoplankton and zooplanktons and harvesting them and using it as food for man and his herds due to its availability and rapid growth.

THE DESERT AS A TERRESTRIAL ECOSYSTEM

The ground or terrestrial environments are more varied than the aquatic environments due to the diversity in the natural conditions such as the climate, the nature of the soil and the plant coverage.
The desert ecosystem can be studied as an example of the terrestrial systems. The desert occupies about 1/5 of all the land area. It is distribution around the latitude 30 above and below the equator in North Africa Central of Asia, the Arabian Island, and South America and Australia. These are arid very dry areas where the average rain is less than 25 ml/year.

The scattered vegetation in the desert ecosystem:

(1) Temporary vegetation

in the form of annual plants appears only in the winter after the rain and withers away by the arrival of draught in summer and disappears after leaving its seeds in the soil. Thus these are normal plants, not specialized for the desert life and their presence depends on the presence of water in the soil.

(2)Permanent vegetation

formed of true xerophytes (desert) plants in the form of herbs, bushes and perennial trees which grow away from each other and are characterized by the increase in the ratio of the root system to the shoot system (whether in length, volume or weight). In some plants, this ratio reaches 80:3.5 meter. Roots of these plants can be divided into two kinds. In the first, the roots extend vertically deep into the soil to absorb the deep ground water. In the other kind, the roots extend horizontally under the soil surface to absorb the dew drops that fall on the soil surface in the morning to make the most use of the scarce water in the desert. Xerophytes plants are also characterized by a thick cuticle cover to protect the plant from evaporation. The leaves are also reduced in size to keep the plant water from transpiration.

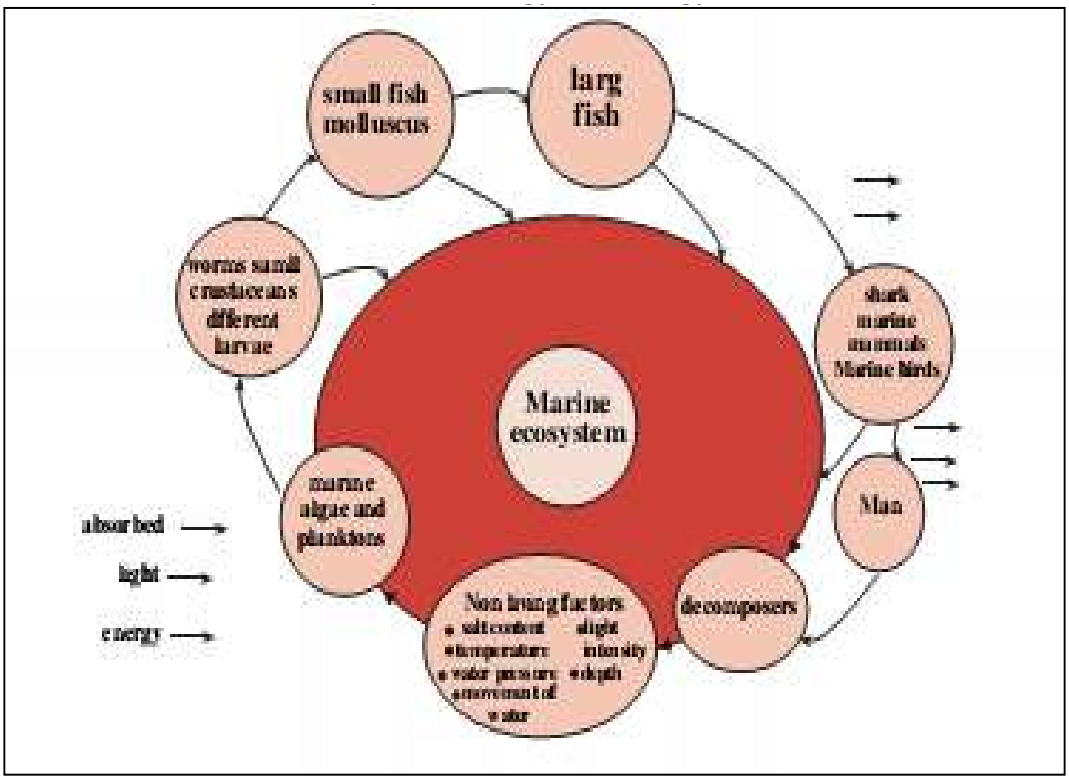
2. The consumers which divided to two kinds:

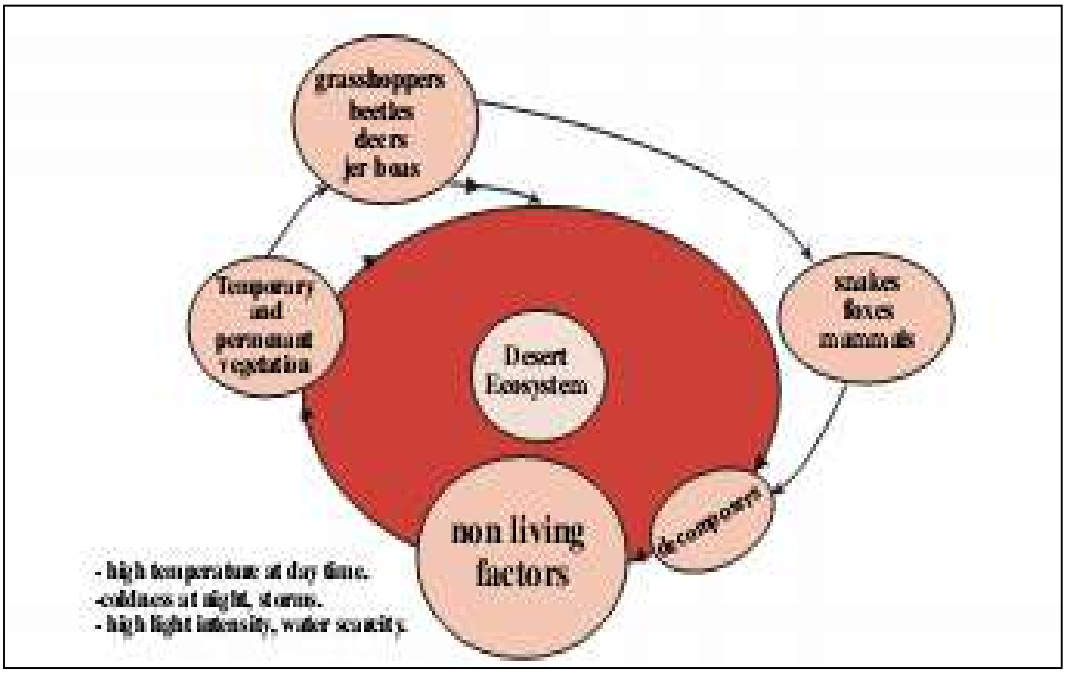
a) Herbivorous

Many different kinds of desert insects such as grasshoppers and beetles, some reptiles that developed tight protective covering around their bodies to keep the water. Some desert mammals such as rodents and dears which are adapted to this hard environment. Most of these animals are active during the night or early in the morning and hide during the day in ditches or humid tunnels. Its urine is concentrated and its perspiration is reduced very much to economize on water as some of these animals do not touch water all its life such as jerboas which extract water from the seeds and the succulent plants on which they feed.

b) Carnivorous

- Some snakes, foxes and other birds which depend on the blood of its preys as a source of water in the desert environment of the desert feed on these jerboas.
- The number of carnivorous animals in the desert is small in order to be balanced with the number of its productivity.
- These carnivorous and their preys are characterized by sharpness in hearing, smelling, and seeing for survival in this environment.
- These animals have big ears as it is the case with the fox, so that it can collect sound waves from for distances in additions to their participation in the dissipation of the body heat.





The environmental resources Depletion

The environmental recourses are everything found in the natural environment from components which man has nothing to do with its presence or creation, but he depends on it in his various life aspects like: food, houses and clothes.

The types of the environmental resources:

- **The renewable resources** are those resources are constantly available in the biosphere because of its ability for continuity and renew unless man causes its extinction or its depletion and deterioration. Such as plants, animals, water, air and soil.
- **The non-renewable resources** they are temporary resources that will disappear from the environment sooner or later and this depends on a wise use by man or his misuse of it such as oil, coal, natural gas and minerals as metal or non-metal.

The Problem of Resources Depletion and wasting the ingredient of the environment became an urgent problem that should be faced to stop it and to remedy its effect. There are several aspects of depletion such as: the misuse of the resources, soil erosion and urban sprawl on agricultural soil and the effect of these on decreasing the sources and the extinction of the living species. In the following we will deal with some of these aspects:

The depletion of the natural resources:

The interaction between man and environment is as old as the appearance of the human race on the Earth planet. Since the settlement of man in the environment. And it satisfied his needs and desires. As a result of trying to satisfy the different human needs although the over population that lead to increasing pressures on the environment by depleting its resources. Scientists became aware of the harmful effects of misusing the resources of the environment and realized the necessity of (economizing) rationalizing in its consumption. In fact, man exploited the environmental resources extravagantly to the extent that some of it are about to be depleted. Man started to suffer from the direct effects of his misusing of the natural resources. In the following we will mention some examples of this and its effect on the man and on the environment.

First: the depletion of renewable natural resources:-

a) Depletion of the agricultural soil:

1. The generalization of planting a single crop in the same soil:

The man has learnt by experience not to plant the same crop for two successive years but it has to diversity what he plants. And the biggest mistake we plant a single crop agriculture which aims to plant one crop on the same soil and repeating it for many years. Although getting some economic benefits, but it is temporary because this attitude causes soil exhaustion and its lake of some essential nutrients for plant.

2. using chemical fertilizers:

Many farmers now replace organic fertilizers by chemical fertilizers. As the organic fertilizers have a major role in the natural environment as it activates living organisms in the soil and enters into the food chains thus giving the soil desirable physical characteristics. The using of the manufacturing chemical fertilizers led to the deterioration of the soil and made it more liable to erosion.

3. The overuse of pesticides and fungicides:

The overuse of pesticides led to the disappearance of some useful insects that feed on the harmful ones leading to that the second one becomes agricultural pests. The falling of pesticides on the soil caused soil pollution and the death of earth warms which was aerating soil and make nitrogen available for nodular bacteria to fix it and by that nodular bacteria lost its morphological and functional features.

Solving the problem of farmers' unwise behavior in agricultural needs:

1. Not planting one kind of crop for several consecutive years and following the agricultural cycles.
2. Controlling the use of chemical fertilizers and pesticides
3. Recycling the agricultural waste to organic fertilizers.

4. Transforming the organic matters in the garbage into organic fertilizers.
5. Using synthetic fibers instead of cotton fibers for planting grains.

4. Eroding the agricultural land:

The agricultural land in Egypt was exposed to a big destruction process, which caused eroding and destruction of agricultural land. **Eroding means the removal of the upper layer of the soil to use it in brick manufacturing**. Eroding destroys the soil that was formed through millions of years and make it unsuitable for agriculture at the same time the government is dedicating all efforts to increase the area of the agricultural land.

In addition of the fact that building the high dam prevented the precipitation of clay on the valley's soil, as it was used to happen yearly during the flood.

Solving the problem of Eroding agricultural land:

1. Manufacturing bricks from clay, cement, sand and other substances instead of mud.
2. The government had issued laws that prohibiting eroding the agricultural land.

5. Spreading of urbanization (the urban sprawl):

Since the beginning of this century the population in Egypt increased greatly. And by the increasing in population the needs for food, clothing and housing are increased too and also the needs for services such as building schools hospitals and others. The people crowded over the fertile green land to build houses and projects. Thus, for the area of land that is reclaimed on one side, an equivalent area of fertile productive land on the delta and valley was lost. Thus, the urban areas are increased on the expense of the surrounding agricultural land. Thus, we can say that in return for the reclaimed areas with the help of the high dam, the Egyptian man has wasted in return rich lands that were producing much more plants than the land which reclaimed. The spread of urbanization over the cultivated land has been responsible for the loss of almost 30.000 feddans annually from our agricultural land.

Solving the problem of spreading urbanization:

1. Established a number of new cities in uncultivated desert land and establishment of industrial projects in these cities.
2. Provided these cities with the infrastructure, houses, schools and the different services.
3. The government had issued legislations that prohibiting building on agricultural land.

b) Overcutting of trees:

Trees have several benefits to the environment in which it is found.

In industrial areas it acts as natural filter for carbon dioxide gas, besides providing us with oxygen gas.

In agricultural areas, beside the previous effect, it acts as wind and torrents breakers to protect the other plants and it provides shade and wood.

In the forest, trees have other important benefits for the environment like it sheds its leaves periodically. These shedded leaves decompose forming (humus) which nourishes the soil and keeps its fertility. And it ensures almost a constant temperature for wild animals which find in the forest a shelter and a suitable place for its life.

The over cutting of forest trees in the Middle East and North Africa led to the deterioration of the environment in these areas and exposing them to draught It is clearly noticed the effect of draught on the natural vegetation and the cultivated plants and on the life of man.

The bad effects of over cutting forest trees on man can be illustrated in the following:

a) Shortage in the amount of raw materials necessary for many industries such as wood, synthetic fibers and paper.
b) Vagrancy (homeless) of the animals that live in the forest and that lead to its extinction.
c) Deterioration the soil and the natural vegetation due to its exposure to draught factors.
d) Exposing the areas around the over cutting forests to the dangers of torrents and wind.
e) The temperature degree gets higher due to increasing of carbon dioxide gas percentage
f) Destroying the ecological system.

Solving over cutting problem:

1. Cutting trees to a certain amount. Then we should plant instead new trees, thus conserving the forest as an ecosystem which is the most stable one.
2. Expanding in planting trees around each city and have a green belt around each city.
3. Recycling the agricultural and industrial waste instead of tree's wood that extracted from trees.

c) Overgrazing:

The natural grazing provide food for cattle herds which a man raises it and depending on it as an animals' wealth which provide him with protein. When the rate of grass growing less than the rate of animal consumption of grass then it will be overgrazing.

Overgrazing leads to:

* Vanishing plants are suitable for grazing and other plants will have the opportunity for growing and extension.
* Overgrazing leads to the deterioration of the natural vegetation which is always accompanied with the deterioration of the soil and the local climate.
* The erosion factors appear and the soil severe drifting by water rain and wind.
* Grazing lands become arid and dry and unable to absorb water rain.
* Increasing the crawling desert phenomenon as it was happened in the north coast in Romanian ages.
* **Grazing in weed areas** leads to erodes the vegetation and the rule of species unpalatable or the complement their life cycle in a short period so the animal doesn't able to eat it.

Grazing will be organized when the grass growth rate is more than animals' consumption rate to this grass.

The organized grazing

* It is good in reducing the percentage of transpiration and evaporating by removing parts of vegetative group.
* **Grazing in the area of shrubs and trees**, causing an increase in the number and size of these shrubs as a result of the removal of the weeds which compete it on the water.

Some examples of the degradation of natural pastures(grazing):-

* grass lands in The Egyptian north coast that was used for grazing sheep in the ancient times, but nowadays it is deteriorated and dried due to overgrazing and over population.
* The Saudi desert was transformed due to over grazing from an area covered with natural vegetation capable of regenerating itself continuously to a deteriorated area..

Solving the over grazing:

1. The establishment of fish farms and crustaceans to provide proteins.
2. Recycling the agricultural waste to feed animals.
3. Recycling some secondary industrial wastes to fodder.

d)The over hunting of wild and marine animals:

As a matter of fact 45 species of birds disappeared in the nineteenth and twentieth centuries due to chasing them with nets and advanced weapons. The extinction of animals is due to killing or hunting a group of it to the limit that the remaining ones are very few in number thus unable to continue reproduction and that is called overhunting.

The reasons of killing and over hunting of animals in sea and on land are basically to the importance of these animals as food resource besides other reasons such as to get the clothing as the case of wild animals which decreasing in numbers to the limit that exposing it to become extinct as in the case of the fur animals (the mink for example) and also as the first settlers in America those were killed millions of American buffalos (the beacon).

Solving over hunting problem:

1. Establishing of natural protectorates to protect rare species.
2. The establishing fish farms and crustaceans to provide proteins.

3. Issuing laws to criminalize hunting for specific species and seasons and in specific age to be able to reproduce.
4. Raise the awareness of the importance of living organisms.
5. Rationalization of cutting trees, fishing on land and in the sea.

e) Over consumption and pollution of water:

Fresh water represents only 1% of the surface water on the Earth, since sea and ocean water represent 97% and the glaciers at the poles represent 2% This means that the amount of fresh water is very limited. Which is the life of all living organisms in all ecosystems depends on it. In Egypt, we depend on the water from river Nile. Also, some other African countries depend on it. Thus, some agreements were signed to allocate certain amounts of the Nile water to each country. Despite that, we are extravagant in using this water through irrigation by submersion and the unwise human use. and specially the Nile River- this vital artery- which is also exposed to many different pollutants as a result of throwing sewage and agricultural and industrial liquid wastes and detergents without treatment, if we add to this the increased number of consumers due to the over population. Water resources in Egypt are considered the most important factor of the ecosystem and because of the limited water resources we must preserve it from consumption and pollution in all its form.

The government issues laws to protect the Nile from pollution with the awareness of all the people of the importance of preserving the Nile River.

Solving the over consumption of water problem:

1. Rationalizing the consumption: by drip irrigation or spraying and using saving water for planting new area.
2. Not squandering water in personal use, using tap working by infrared rays to save water.
3. Treatment the house used water to irrigate the timber trees.
4. Search for ground water and desalination of sea water and collecting rainwater.

Governmental efforts to combat pollution of the Nile:

1. Determine the percentage of pollutants permitted to derange on the Nile.
2. Selection of pesticide and fertilizers that does not pollute water streams.
3. Force factories to treat industrial wastewater before derange it into the Nile.
4. Continuous inspection on the water streams and removes the causes of pollution.

Second the Depletion of non-renewable resources:

a) Mineral depletion:

Minerals are non-renewable resources that man exploits in different Aspects of his life activities. But with increasing of population and progress of technology, the individuals' share of minerals (cars, equipment, tools, installations, metal coins... etc.) is increasing with very high rate that reaches almost triple the rate of population increase. So, the suggestions of finding alternatives for minerals have an excuse now after the Studies have confirmed that the amount of minerals remaining in the earth is back down rapidly.

Solving the Mineral depletion problem: -

1. Using (elastomers) plastic in manufacturing pipes instead of non-renewable metals
2. Using of feldspar in pottery and ceramics industry (cooking pots) instead of non- renewable metals.
3. Reusing the used car batteries after treating them.
4. Retreatment and reforming the plastic and glass products and reuse it.
5. Re-melting and reforming and reusing metal products that are not any suitable for use.

b) Depletion of the fossil fuel:

Coal, oil and natural gas are non-renewable resources as they are found in limited amounts in the environment and they were formed in deep in the Earth millions of years ago, this means that what is consumed of them cannot be compensated.

In the last century, coal was on the top of the list as it was the fuel used in industry after the invention of the steam engine then it was replaced by Oil and natural gas and their uses are increased day after day for many reasons:

1. Their thermal value is higher than coal.
2. Oil has a fluid nature and natural gas has a gaseous nature which distinguished their easiness of transporting and storing and loading ships, trains and airplanes by them.
3. Coal mining is more expensive than oil and natural gas.
4. Oil and natural gas became the core of life; oil is used daily in huge amounts in the internal combustion engine and also Natural gas is used as fuel in houses and factories.
5. Oil is not only an energy source, but recently there are many chemical industries basically depend on components or oil derivatives and it is called petrochemical industries, which produce most of what man need in his life and those product synthetic fibers, detergents, dyes, paints, packaging bags, medicine and other products which are essential for life and that have the higher economic return and less polluting to environment than using oil as fuel.

The consumption of oil and natural gas is increasing year after year. A report estimates shows that in the developed countries, the individual's consumption of energy increases by 3% yearly. And the developing countries started industrialization, and many of them have taken big steps in this field. Thus, the international consumption of energy is doubling every ten years. So, we mustn't depletion of coal, oil and natural gas and prepare ourselves scientifically and technically for the day that oil scarce before it completely depletion, which will cause many harms to Man. Thus, the scientists succeeded to get energy from water falls, solar energy, wind energy and tide energy and etc.…Thus efforts are being expended towards how we can get benefits from them

Solving the problem of Depletion of the fossil fuel:-

1. Rationalizing oil consumption and find suitable substitutes for it.
2. Using solar and wind energies as they are the most suitable energy that can be utilized in Egypt because they are available all the year instead of oil and natural gas because they are non-renewable resources.
3. Using coal instead of oil because it is more available and with solving the pollution problem.
4. Raised reactors for power generation from nuclear fuel using uranium instead of oil but this is still limited due to large costs and the many safety precautions to be taken to protect humans and the environment from its dangerous.
5. Manufacturing Cars work with electricity by using solar cells because they are saving fuel from oil and does not pollute environment.
6. Conversion of animal waste and agricultural waste to methane gas (biogas) which is used as fuel.
7. Re-using car oils after treatment.